Radio, Electronics and Communications

FORMERLY "RADIO & ELECTRICAL REVIEW" — WIDELY KNOWN SINCE 1946 AS "R. & E."

In This Issue . . .

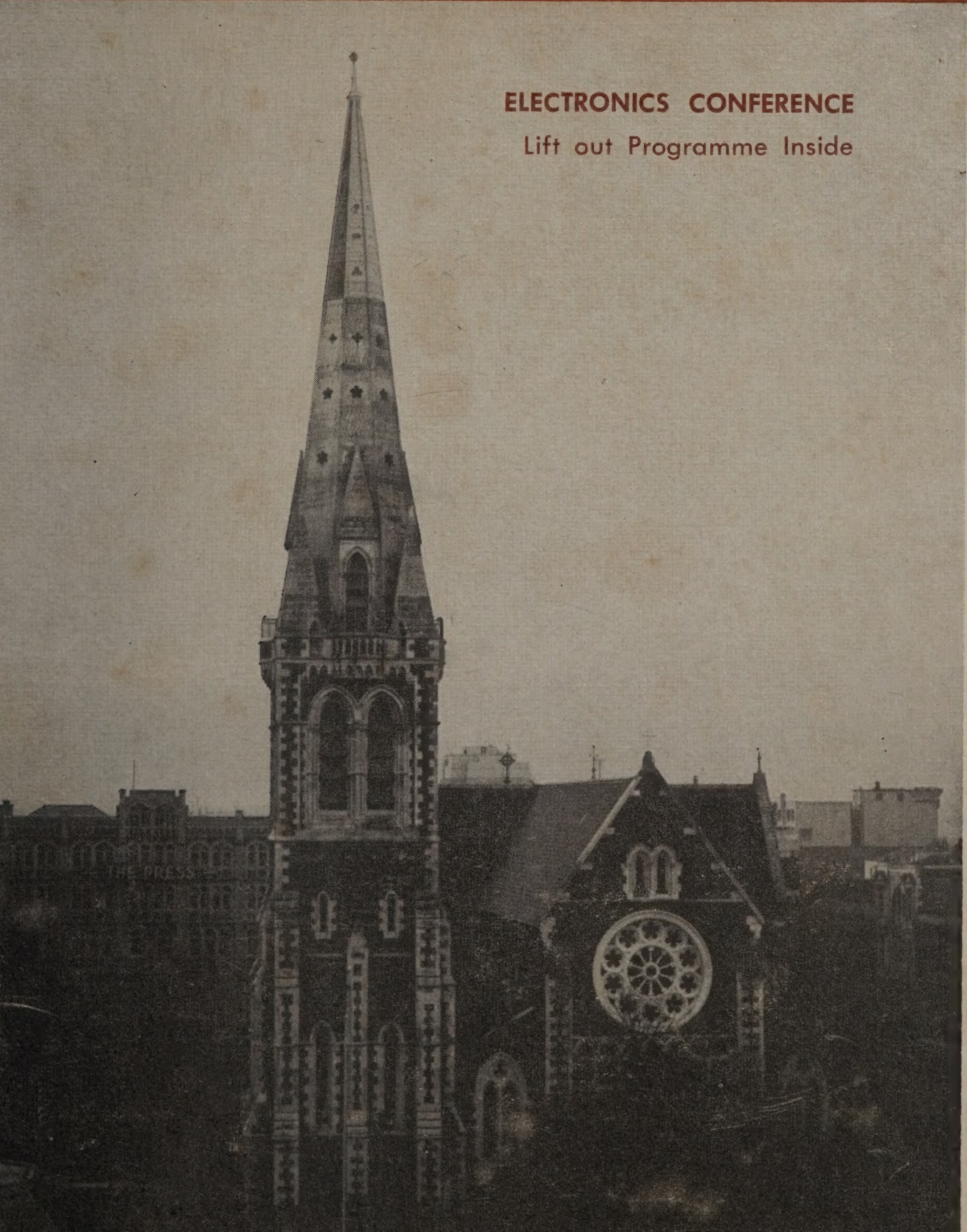
- Looking at Semi-Conductor Strain Gauges.
- Accuracy Specifications for Measuring Instruments
- Magnetic Heads
- A simple method of measuring the attenuation of Coaxial Cables
- Selection of Abstracts of Electronics Conference Papers
- Transmission Lines for 432 mhz.

PUBLISHED MONTHLY IN THE INTERESTS OF THE N.Z. ELECTRONICS INDUSTRY FOR ALL LEVELS, FROM PROFESSIONAL TO AMATEUR.

VOLUME 21 NUMBER 4

JUNE 1, 1966

PRICE 2/6



ELECTRONICS CONFERENCE

Lift out Programme Inside

AWA AUDIO REINFORCEMENT SYSTEM FOR CHRISTCHURCH CATHEDRAL

ENQUIRY CARD AD. 1

whenever there's "just a valve" to be replaced . . .

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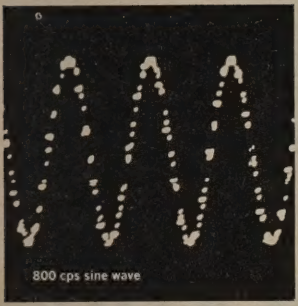

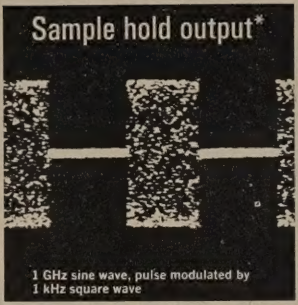

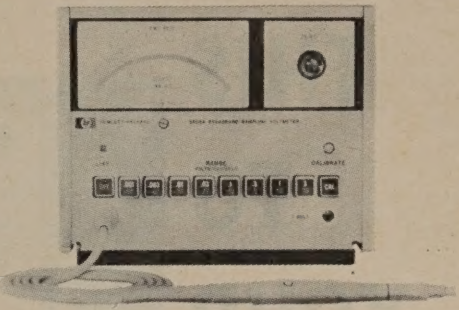

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measure 1 MV to 3 V, 10 kHz to 1 GHz!

- 50 µV readings with 20 µv resolution
- ±5% measurements at 700 MHz (usable to 2GHz)
- Linear scale on all ranges
- Recorder and sample hold outputs
- Probe with measurement retention
- Price—only £349/7/6

Voltage range:	1 mv to 3 v full scale, 8 ranges; db −50 to +20 dbm (0 dbm = 1 mw in 50 ohms); absolute average-reading instrument calibrated to rms of sine wave
Frequency range:	10 kHz to 1 GHz, useful sensitivity 1000 Hz to beyond 2 GHz
Full-scale accuracy:	±3%, 10 kHz to 100 MHz; ±5%, 100 MHz to 700 MHz; ±8%, 700 MHz to 1 GHz
Input impedance:	100,000 ohms at 100 kHz, capacity appromixately 2 pf (input capacity and resistance depend on accessory tip used)
Outputs:	dc recorder, 1.2 ma into 1 K ohms at full scale, proportional to meter deflection; ac, sample-hold output—ac signal statistically equivalent to measured signal (on ranges 0.01 v and above)
Meter scales:	linear voltage, 0 to 1 and 0 to 3; db, −12 to +3; individually calibrated tautband meter
Dimensions:	6½" high, 8⅞" wide, 11½" deep (165 x 225 x 292 mm); 8 lbs
Accessory furnished:	11072A Isolator Tip
Accessories available:	11064A Basic Probe Kit (£53/15/0) 11063A 50 Ohm "T" 10214A 10:1 Divider Tip 10218A BNC Adapter (09500090) 50 Ohm Termination 11071A Probe Kit (£99/8/9) consists of above, plus— 11073A Pen Type Probe 10219A Type 874A Adapter 10220A Microdot Adapter 11035A Probe Tip Kit

PRICES SHOWN ARE DUTY PAID

A DC VOLT-OHMMETER WITH NO RANGE SWITCH!

More time saved—Put an end to tedious, time-consuming manual range switching with the new Hewlett-Packard 414A Autovoltmeter. Just touch and read . . . range and polarity change automatically. You read range and polarity on the digital readout above the analog meter.

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More uses—The 414A is the world's first "touch-and-read" analog volt-ohmmeter with accuracy anywhere approaching what you require for trouble shooting, tweaking, peaking and nulling, probing a circuit without a schematic. Use it for maintenance testing, on the production line, in the lab.

In the dc voltage function you simply touch the point to be measured and in less than 300 msec read the range and polarity on the digital display and the precise dc measurement on the individually calibrated, mirror-backed taut-band meter. Automatic ranges are selected and displayed for resistance measurements, too.

More noise rejection—Ranges also can be selected and held manually, and a Down Range control feature lets you drop to the next lower range merely by pushing a frontpanel button.

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ENQUIRY CARD AD. 5

MATCH THIS TO YOUR APPLICATION

New hp 3300A Function Generator

3302A Trigger Phase Lock Plug-in

First Plug-in Function Generator to offer variable phase, phase-lock capability . . . plus these useful features:

Accurate sine, square, triangular waveform output, amplitude controlled
Test signals 0.01 Hz (cps) to 100 kHz (kc), constant amplitude
Linear voltage programmability
Single-cycle, multi-cycle, free-run modes, with external trigger capability
Dual output amplifiers, uniquely isolated for maximum versatility
Sync pulse output for scope or recorder

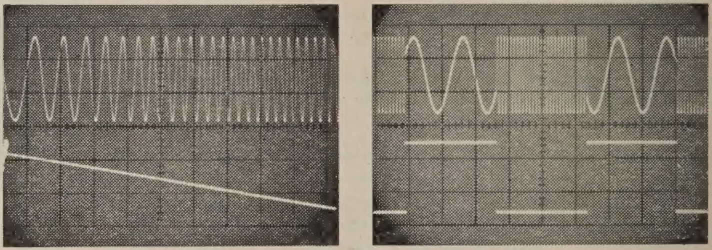
Versatility finds a real definition in the new hp 3300A Function Generator, £306/7/6, with its 3301A Operational Plug-in, £10/15/0, and its 3302A Trigger/Phase Lock Plug-in, £102/2/6 . . . with more plug-ins to come!

All this for just £408/10/0.

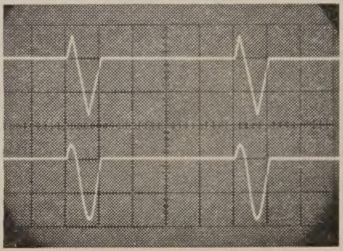
Any two of the three waveforms selectable by a front-panel switch, amplitude individually adjustable, over the entire frequency range. Frequency adjustable by front-panel dial (±1%) or by external voltage (+0.3 to 10 V will control frequency approximately 50:1). With the 3302A Plug-in, you also get single- and multiple-cycle operation with variable start/stop phase. Trigger input lets you phase lock onto fundamentals, harmonics, lock indicated by front-panel meter.

Output is dc coupled, fully floating, with an internal shield that reduces radiated interference and provides high CMR. Apply any dc offset voltage, up to ±250 V, using circuit, shield and power line rear-terminal grounds. You can use Channel B to invert the signal from Channel A, useful for driving balanced systems and other applications. 40 DB dynamic range, each amplifier, up to 35 V p-p into an open circuit, output impedance 600 ohms.

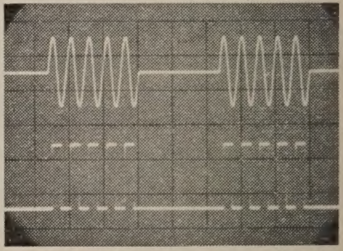
Here is an instrument that has to be seen to be appreciated: ideal for servo, medical, analog simulation, geophysical, subsonic and audio, vibration and frequency response applications. Explain your requirement to Sample Electronics. Or write for complete specifications. Prices shown are duty paid delivered anywhere in New Zealand.



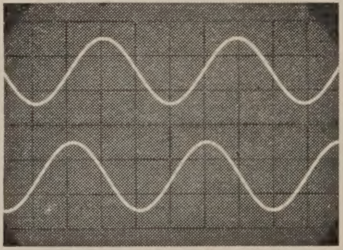
Voltage programming; frequency upper trace, programming voltage below.



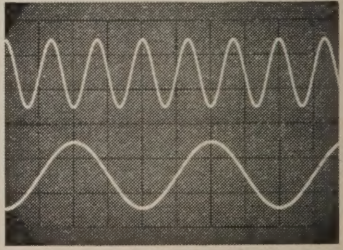
Single cycle—simultaneous triangular and sine outputs.



Multiple cycle—bursts of simultaneous sine and square-wave outputs.



Phase lock; output from function generator (upper trace) locked to external *fundamental* (lower trace).



Phase lock; output from function generator (upper trace) locked to external *harmonic* (lower trace).

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ENQUIRY CARD AD. 4

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You'll find a refrigerant ideally suited to your particular needs in the wide 'ARCTON' range.

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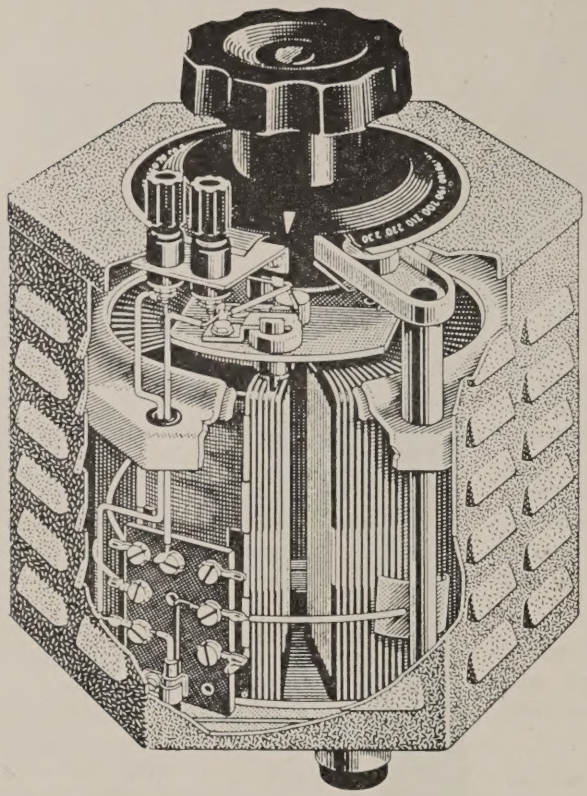
PHILIPS *Variable transformers*



Philips variable transformers are designed and manufactured with such care that they will give reliable service over a long period of life. They are available mounted in a durable, attractive case or without the case for panel mounting.

★ Can be mechanically coupled for series, parallel or 3-phase (star connected) operation.

★ Accurate and uninterrupted regulation.

★ Individual units rated up to 2 kVA.

★ Low weight, small dimensions.

★ Continuously variable from zero to 20% above input voltage.

★ Highly efficient due to extremely low "no-load" losses.

★ Toroidally wound.

★ Low cost.

★ Suitable for ganging and combining.

★ **All models available ex stock.**

IMPORTANT!

Recently released overseas and an ESSENTIAL for all TV service work is the new Philips double-wound ISOLATING variable transformer. These transformers have a power rating of 350 watts which is more than sufficient for all TV service work. They are available for bench mounting complete with fusing and voltmeter, or for panel mounting. Further particulars on request. Limited stocks only are available.

Write or telephone today for further particulars
Illustrated catalogue available.

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AUCKLAND.

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Volume 21, Number 4 June 1, 1966

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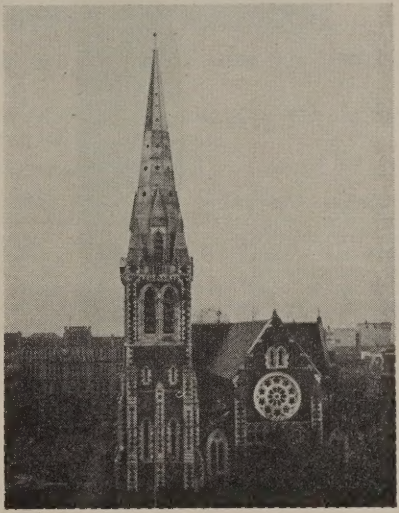
On Our Cover



A contract to provide an extensive sound system for the Anglican Cathedral, Christchurch, was recently awarded to Amalgamated Wireless (Australasia) N.Z. Ltd.
A complete coverage of the church was required so that all parts of the service could be heard clearly by the congregation. To achieve this, nine AKG type D19C microphones were used in conjunction with a specially designed transistor mixer-preamplifier which feeds an AWA 50 watt PA amplifier driving sixteen column speakers In addition to this, an induction loop hearing aid system is provided, this being driven by an AWA 100 watt PA amplifier.
The mixer-preamplifier has four channels, each channel being switchable to either of two microphones. There are three isolated outputs as well as visual and aural monitoring facilities. The speakers are provided with preset attenuators to enable levels to be adjusted according to the location.
So that the equipment would blend in with the surroundings, the colour of the speakers had to be chosen to match the Oamaru stone pillars on which they are mounted. Also microphone stands were plated in florentine bronze.
The new system replaces one which was installed 15 years ago.

ENQUIRY CARD AD. 6

Coming . . .

A Converter for 432 mhz
Looking At Glow Discharge Tubes
Sub-ionospheric propagation of VLF Radio signals
TV Kitset in two parts
Properties of the Ionosphere which affect H.F. Transmissions
Closed Circuit TV System

Also . . .

Serviceman's Column
Listening Post
Laboratory Report
Conference Report & Papers

ENQUIRY CARD AD. 7

PYE

FIRST IN NEW ZEALAND!

A major achievement by New Zealand engineers in the design of Marine Radio Telephones.

INSTANT SAFETY Who needs a mass of equipment? Pye offers the smallest, lightest marine radio telephone yet made — but it packs the biggest punch imaginable! With space at a premium, boats need a unit that'll tuck out of the way. Pye does it. Their Ship-To-Shore Radio Telephone contains no valves, uses much less power and can operate on dry batteries. Suitable for any craft afloat, this unit features a broadcast band with automatic selection of the receive frequency, seven transmitting and receiving channels — and most important for emergencies — no delay, no thirty-second-warm-up before you send or receive. Average input power 35 watts. Emergency channel indicated by warning light. Price with 2182 crystals, is £72.0.0.

THE PYE SHIP-TO-SHORE RADIO TELEPHONE GIVES YOU LESS FOR YOUR MONEY

(YET IT PACKS THE PUNCH OF A GIANT)

For full specifications, write: PYE TELECOMMUNICATIONS DIVISION, P.O. BOX 2839, Auckland, Phone 548-038.
Branches at Hamilton, Phone 81-429, Wellington, Phone 55-020 and Christchurch, Phone 69-203. AA. 1867

Letters from Readers

Sir,

I wish to obtain some Pre-recorded tapes suitable for checking distortion in playback amplifiers. Could you help me in the matter of a likely source of such tapes.

D. G. JONES,
Te Awamutu

We are not sure of a ready source of pre-recorded tapes suitable for checking distortion. However, we suggest the N.Z. Tape Recording Club, which has a tape library, may be able to help. Their address is P.O. Box 5368, Wellesley Street, Auckland.

If they are unable to assist we feel sure Mr. Judd with whom we have previously had correspondence may be able to assist. His address is F. C. Judd, Amateur Tape Recording, Haymarket Press, 86-88 Edgeware Road, London, W.2, England.

—Ed.

Sir,

Would you please be good enough to advise value of R1 and R2 resistors on page 12 of Volume 21 April 1966.

J. J. COCKROFT
Timaru

We regret the omission of the resistor values in the amplifier article to which you referred. R1 is 100 ohms and R2 is 3.3 K.

—Ed.

EDITOR'S NOTE:

We have received an enquiry from the National Research Council, Ottawa, for the following list of back issues of Radio, Electronics & Communications:—

Vol. 7	Nos. 1 - 5	1952
Vol. 8	No. 2	1953
Vol. 9	No. 2	1954
Vol. 11	No. 7	1956
Vol. 15	No. 2 & 4	1960

Since we are unable to supply, we would appreciate advice from any reader who may be able to help. Naturally we regard it as a good thing that these copies are being sought to complete the Council's records and we would like to assist if possible. Please write to the Editor if you can help.

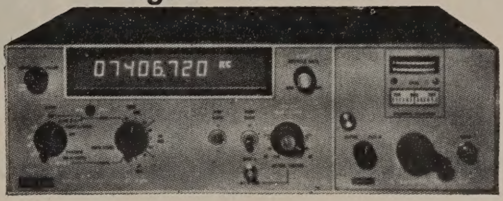
See the lift-out conference programme pp 19-22

ENQUIRY CARD AD. 8

ENQUIRY CARD AD. 22

Beckman®

Digital Instruments



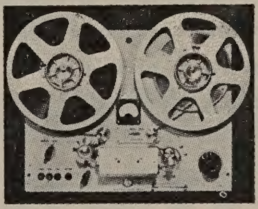
Illustrated is Model 6126 eput meter with model 607 1000—MC plug-in extender.

Among other models available is the model 6146 eput and timer with Model 602 100Mc plug-in extender.

(End obsolescence with plug-in extenders)

100—MC CONVERTER—With a Beckman Model 607 Heterodyne plug-in, you can convert a Model 6126 or Model 6146 to a 1000-megacycle digital frequency meter. Unequalled in bandwidth, this compact, solid-state unit has a single control for continuous, non-critical tuning from 20 to 1000 mc in 20-mc increments. By simply turning a switch, you can measure below 25 mc or perform other measurements with the basic counter—without removing the heterodyne converter. The Model 607 Heterodyne plug-in makes your 6100 Series instrument the highest frequency, lowest cost-per-megacycle counter available.

100—MC EXTENDERS—The frequency range in which direct measurements are made by either of these 25-mc counters can actually be quadrupled. The compact Model 601 plug-in unit transforms the Model 6146 or Model 6126 to a true direct-counting 100-megacycle EPUT meter—no tuning involved. In addition, this unit provides 10-nanosecond resolution for period measurements—effectively increasing resolution by a factor of ten. A similar plug-in unit—the Model 602—not only increases the direct-counting range of either of these counters to 100 mc, but incorporates two channels for measuring time intervals with 10-nanosecond resolution.



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MAGNETIC RECORDING EQUIPMENT

Heavy duty tape recorders, battery operation—Series C and D.
Heavy duty tape recorders, A.C. mains operation—Series E.
Magnetic film recorders—Series F.
Magnetic film reproducers—Series FR.
Film loop absorber.
Syncropulse interlock system—recorders and automatic reproducers.
6-Band audio equaliser—Model 46X.
Disc reproducer console.
High speed tape duplicating system—single and multi-channel.
High speed tape inspection and reclamation unit.
"Leeraser" bulk tape demagnetisers.
Photo-trip automatic programming system.
Mixing consoles, single channel and time multiplex monitor systems, distributors and patchfields—to specification.

For information on Leevers-Rich comprehensive range of quality recording equipment contact the sole N.Z. agents.

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Motorola Semi-Conductors news flash !

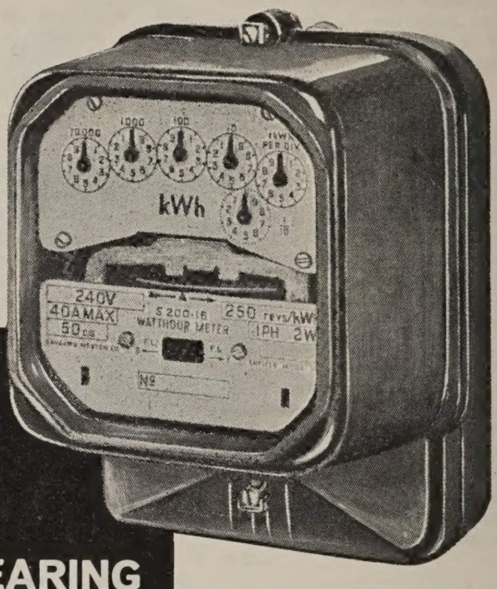
New low priced plastic enscapsulated integrated circuits available shortly. Enquiries welcomed.

ENQUIRY CARD AD. 9

sangamo

S200·16

SINGLE PHASE WATTHOUR METER

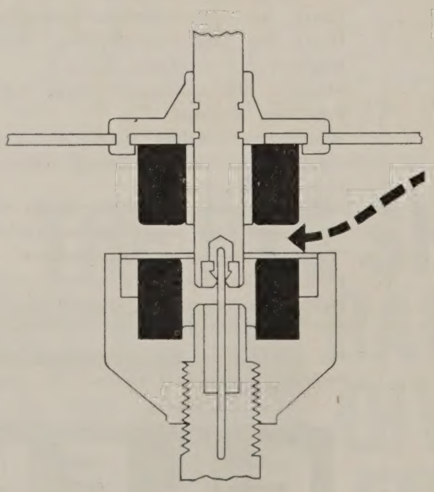


WITH FLOTON

MAGNETIC FLOTATION BEARING

Already the Sangamo model S.200 meter is years ahead of its time. More iron and copper in both the potential and series elements to give a better load curve. Quantity production bringing economies which are passed on to the user in finer materials, finer specifications. Quality control at every stage. And now Sangamo are first in production with magnetic flotation of the disc spindle, completely eliminating bearing wear . . . giving even longer life and sustained accuracy to the world's longest-life meter.

Disc spindle completely floats on a magnetic cushion eliminating wear and ensuring sustained accuracy



WIDE CLEARANCE IN REPULSION SYSTEM One of the outstanding features of the system is the self-cleaning of the magnetic gap. The repelling fields of the floating magnets have a generous clearance of approximately $\frac{1}{16}$" in depth and can readily be inspected from the front of the meter. These repelling fields prevent magnetic particles from bridging the magnetic cushion and thus creating a source of friction.

BARIUM-FERRITE CERAMIC MAGNETS These magnets, of exceedingly high coercive force, cannot be de-magnetised by the most powerful magnetic field caused by extreme overload on the meter, or by external magnetic fields. Being ceramic, they are completely corrosion proof.

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ENQUIRY CARD AD. 10

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to the use, characteristics and range of PHILIPS semiconductors!

A COMPLETE REFERENCE BOOK FOR ONLY 15/-

This reference book of the PHILIPS range of diodes, transistors and rectifiers, gives detailed specifications of their application and characteristics. It offers a quick and handy reference to the technician searching for the right semiconductor to do a specified job. No reference library is complete without it.

FILL IN THIS COUPON OR WRITE TO:
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P.O. Box 2097, Wellington.

Attached is my cheque/money order for 15/-. Please forward by return mail, a copy of the reference book "Philips Semiconductors".

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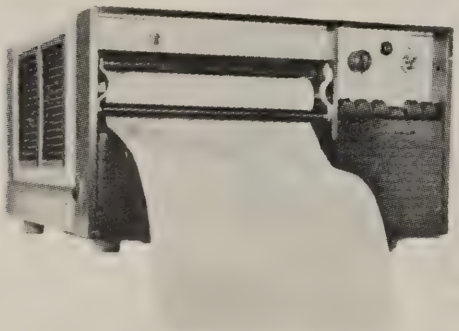
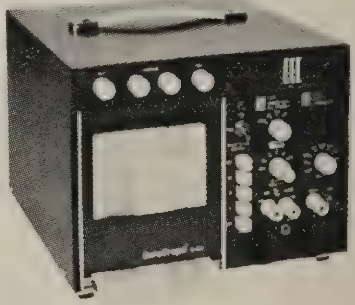
Analytical & Control Division: Manufactures Datatape and Datagraph products including magnetic tape recording and reproducing equipment for ground-station, airborne and mobile application, direct-writing oscillographs, amplifiers, power supplies. Transducer products—Sensing devices for industrial and military applications, pressure and vibration instrumentation, and galvanometers. Technical supplies—Markets expendable supplies for the instrumentation field such as magnetic tape, and processing chemicals and recording materials for oscillographs.

Data Instruments Division: Produces mass spectrometers, emission spectrometers, residual gas analysers, leak detectors, chromatographs, and moisture monitors.

Consolidated Vacuum Corporation: Manufactures a complete line of high vacuum and environmental test equipment for science and industry . . . including custom systems.



Consolidated's Type 5-124 DATAGRAPH Recording Oscillograph brings precise measurement within the reach of all: The instrument's low cost makes top quality recording available to many industrial and medical users who once though such instrumentation inaccessible. Yet, the oscillograph's excellent performance characteristics make it suitable for some of today's most sophisticated aerospace applications. Channel capacity is 6, 12, or 18, with 7-inch-wide records produced by the direct print process, which means no chemical processing is required. Using CEC 7-300 Series High Performance Galvanometers, static and dynamic data from d-c to 13,000 cps can be recorded. Standard recording speeds are ¼, 1, 4, 16, and 64 inches-per-second.



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Electronics battles road deaths

Despite all the efforts of the Transport Departments of Government and local authorities, the mounting total of road fatalaties will approach if not pass the figure for 1965. Whereas electronics has played its part in improving the safety record of aircraft, ships and railways, there appears to have been little activity in the case of the motor car and the roads on which it travels.

Can electronics do something to reduce the road toll significantly? This question comes up more and more often, and although it is usually answered vaguely in the affirmative, it is also generally qualified by the rider that this is likely to be in the distant, rather than the immediate future. Why? It is shortage of money, lack of interest, or is it impractical at the present state of the science?

It must seem a little incongruous to the layman that modern technology can guide a satellite far out into space, make it execute delicate manoeuvres, and land softly on the moon and yet the humble motor car cannot progress safely along a city street.

In some of the larger cities of the world, traffic patterns are detected by systems incorporating closed circuit TV, sensing pads and helicopter borne observers and this information is digested by computers. This enables traffic control lights and warning signs to be activated in such a way as to correct any potential obstruction to traffic flow. On some overseas motorways, accident and road safety signs can be illuminated by a central control to advise motorists of impending danger. So far, however, there has been little attention paid to providing any equipment to aid the driver in his actions.

The gathering momentum of experimental work is at least a little promising however and many safety experts believe that if the future driver is to survive at all, it must be as the result of teamwork between law-makers, car manufacturers and electronic laboratories. It was for this reason that a different approach aroused interest early this year, when it was proposed overseas to build a "Drivometer" device which would establish a potential "figure of merit" for drivers, by measuring their reaction times for certain situations.

An extension of this idea could be the use of a Driving Simulator, such as the unit which was introduced last year in the United States, by the American Division of Accident Prevention. This simulator shows up potentially dangerous driving practices and accident-prone situations. For example: one of the first-projects is an attempt to discover what causes high-speed rear-end motorway collisions, and also how a driver reacts under varying traffic conditions. By using such techniques, it is hoped to produce data on such subjects as driver fatigue and partially or defective, vision.

Here electronics is playing its part in an indirect way to help prevent accidents. Some writers, with tongue in cheek perhaps, have suggested that cars should be fitted with automatic light-dipping systems, and radar operated brakes. However nothing really concrete has come of these ideas to date, and it is painfully obvious that for the next few years, at least, comments made earlier in this article are likely to remain true — unfortunately for some of those who will be travelling and risking their lives on the highways.

I.H.S.

Following the Suva yatch race earlier this year we prepared an editorial comment on the subject of safety at sea. However in view of the subsequent tragic loss of the Kaitawa and the impending inquiry we have at least temporarily reserved our comments.

—Ed.

LOOKING AT SEMI-CONDUCTOR STRAIN GAUGES

Around the end of 1958 considerable interest developed among experimenters and acoustical transducer manufacturers in the possible application of highly sensitive piezo-resistive elements as sensing devices for displacements, strains and forces. For dynamic problems, piezo-electric pickup systems consisting of quartz or barium titanate had been used for measuring vibrations and shock and stress waves.

Wire strain gauges utilising a change in dimension to give a change in resistive value, had been known since the late 1930s, but to the author's knowledge, the first piezo-resistive measurements on semi-conductors were made in 1953 in connection with basic research into transistor technology. From this point on, further investigation and experiments were very actively carried out, and efforts were made to find and extend applications of the phenomenon.

Whereas the strain sensitivity (gauge factor) for conventional wire gauges is commonly about two, it was found that gauges made from semi-conductor material have a gauge factor often greater than 100. Nowadays, manufacturing methods can yield gauge elements with small volume and area capable of high resistance changes, enabling almost pin-point measurements to be made on small or intricate members or articles.

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Mechanical properties of semi-conductor strain gauges

Strain gauges can be made from semi-conductor materials based on silicon and germanium doped with certain impurities. Properties such as the electrical resistivity, the temperature dependance of resistivity, the magnitude of the piezo-resistance effect and its temperature dependance are all functions of the "doping level" or concentration of the impurities in the basic element's crystal lattice.

By doping with the right impurity, (for example phosphorous), silicon material can be produced from which gauges can be made with a negative gauge factor (the resistance here decreases on application of a tensile strain). Silicon doped with an impurity such as boron will enable gauges to be made with a positive gauge factor. Consequently, these two types are usually known as n-type and p-type respectively.

The material commonly used at the present time for commercial semi-conductor strain gauges is single crystal silicon, since this type of material shows a large piezo-resistance effect and has good mechanical properties, being inherently free from hysteresis and memory effects found in multi-crystalline elements such as wire and foil sensing elements.

The strain sensing element of a silicon strain gauge should be cut from a single crystal of the semi-conductor material, with suitable orientation relative to the crystal axes. When cut in the form of a very thin strip this material is sufficiently flexible to be bent round a radius of less than one quarter of an inch, yet such strips are very strong.

Thus the outstanding features of silicon type strain gauges are that they exhibit a very high gauge factor, and they can be obtained with this gauge factor either positive or negative.

The determination and control of the effects of temperature on silicon gauges

The basic silicon element and termination assembly of a typical semi-conductor strain gauge would be capable of withstanding temperatures well in excess of 300 degrees centigrade, but in practice, the gauge has to be mounted onto the structure under examination, and in many cases the adhesive methods impose a lower limit to the acceptable maximum temperature.

Commercial silicon strain gauges are commonly mounted on synthetic or epoxy-resin substrates which

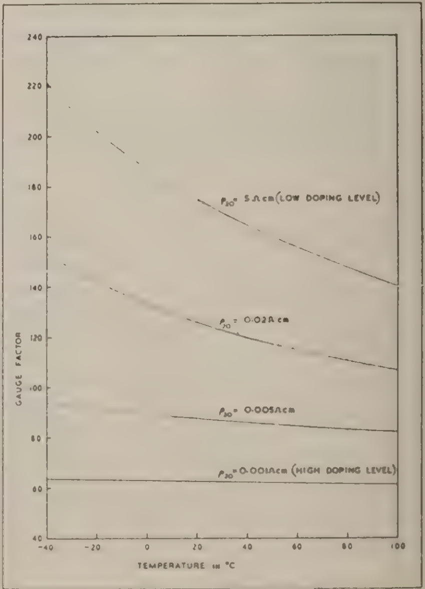

Fig. 1. Gauge factor versus temperature for silicon strain gauges produced with various doping levels, indicated by the resistivity at 20 degrees Centigrade.

limit the maximum temperatures to about 100 degrees centigrade. In some cases the effects of temperature on these substrates is responsible for some of the temperature effects of the gauge itself. There are other temperature effects, however, which are caused by the semiconductor material itself. These effects can be reduced or alleviated in many ways.

Some of the undesirable effects are:

1. The change in the resistivity of the material with temperature.
2. The change in sensitivity, e.g. the piezo-resistance coefficients of silicon material decreases with an increase in temperature.
3. There is a change in the "unstrained" resistance of the gauge resulting from a difference in expansion due to temperature of the gauge and the structure on which it is mounted.

The combination of these effects and some others, makes it necessary to use some form of temperature compensation. These techniques can be of two basic types, namely,

1. Self compensation.
2. Circuit system compensation.

Let us first look at methods of self compensation.

In Fig. 1. we see the effects of temperature versus gauge factor as a function of the amount of impurity introduced by the doping process. As the impurity concentration is increased, the ambient temperature resistivity of the material decreases, and the temperature dependence of gauge factor decreases, but so does the gauge factor itself.

Thus for a large operating temperature range, it is better to use a lower resistivity material, tolerating the lower strain sensitivity. If the temperature range is small, the resistivity can be increased by using material with lower doping concentrations thus securing a higher gauge factor.

If the impurity doping is greater than about 10^{20} atoms per cubic centimetre (corresponding to resistivities less than about one thousandth of an ohm per centimetre) the gauge factor is relatively independent of the temperature. To secure this doping level however, special techniques are required, for example, the impurity is diffused into the silicon for a limited distance at a very high temperature. This gives a gauge of reasonable dimensions with a suitable electrical resistance.

Gauges can also be made which have an element of p-type material and an element of n-type material mounted side by side on a common substrate. These two types of material have gauge factors of opposite sign but temperature coefficients of resistivity of the same sign. By carefully chosing doping levels, it is possible to arrange matters so that the resistance of the two arms change at the same rate with variation of temperature. If these two gauges are now connected in opposite arms of a Wheatstone bridge, the bridge will remain balanced over quite a wide temperature shift. Unfortunately, these composite gauges have to be designed to suit the thermal expansion characteristics of the material on which they are to be mounted finally.

Compensation by means of circuit design

Compensation for temperature can be achieved in this manner, in a variety of ways. Some however, are not completely satisfactory. For instance, two gauges can be used in opposite arms of a bridge circuit. One of these is active, the other is located so as to be held at the same temperature, but it is inactive. In this way, compensation can be obtained for the variation of resistance with temperature, and for the effects of expansion with temperature but does not compensate for the change of gauge factor with temperature.

A method which is useful when equal positive and negative strains are available, as for instance with opposite surface of a bending beam, is to use four identical gauges in a 4 sided bridge circuit, with the adjacent arms subjected to strains of opposite sign.

Any temperature effect will be balanced by the bridge, but there is still no compensation present for the effects of temperature on gauge factor.

With this system it is possible however, to compensate for changes in gauge factor with temperature by using thermistors in series with the bridge. The basic circuit is shown in Fig. 2. One slight disadvantage of this technique is that a comparatively large thermistor must be used since it must handle a large fraction of the total bridge current. The fraction of the input voltage appearing across the bridge depends on the resistance of the thermistor; as the temperature increases, this fraction also increases due to the fall in resistance of the thermistor. The values of thermistor and shunt resistor are chosen so that the increase in voltage across the bridge produces an increase in output, which balances the fall in output resulting from the decreasing gauge factor. The thermistor must be mounted so that it is at the same temperature as the gauges.

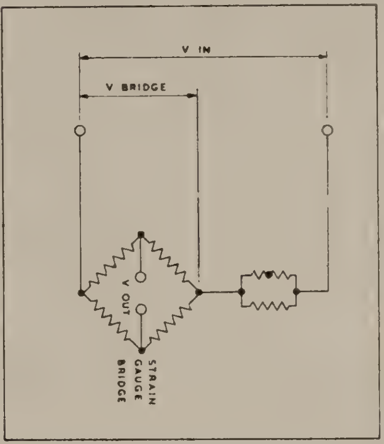

Fig. 2. Thermistor circuit for the compensation of the change of sensitivity with temperature of semi-conductor strain gauges.

An alternative arrangement is to use the gauges themselves as the temperature-dependent element and to place a fixed resistance in series with the bridge. If gauges with a high temperature coefficient of resistance are used, then the bridge resistance will increase sufficiently with temperature for the increased voltage across it to compensate for the fall in gauge factor. This method has the advantage that the resistor in series with the bridge does not have to be the same temperature as the gauges, and therefore does not have to be mounted with them.

Some applications of the semi-conductor strain gauge

The large output from silicon semi-conductor strain gauges has enabled them to be used in applications where previously strain gauges could not be considered. For example there are many cases where it is advantageous to have an indication of the load acting on some part of a machine or mechanism during its normal operation, in some cases for safety, in others for more efficient operation. A high order of accuracy is usually unnecessary, and it is often possible to find some part of the mechanism where sufficiently high strains are present to produce useful measurements.

The output can be used to drive such indicators as a moving coil milliammeter or relays operating signals, or where the load must be safely controlled, the strain gauge can be used to trip safety interlocks if the load becomes dangerous.

Where linear or small angular movements are to be measured or detected, the movement can be used to deflect a flexible arm, to which are bonded two or four gauges. By attaching one or more pairs of gauges to the outside of pressure tanks or pipes, the internal pressures can be detected or changes of pressure measured.

Strain gauges are known for their good frequency response characteristics, and high measurement accuracy. For this reason, strain gauge load cells and tension links are particularly suited to weighing applications.

Generally they are simple to install, and due to the small deformation of the sensing element under loads have little effect on the normal operation of the instrument.

Undoubtely more experience of the use of silicon strain gauges in industrial applications will result in designers finding that strain gauges can be used profitably to do countless jobs more effectively than has hitherto been possible. Although the initial cost of these semiconductor gauges is high compared with metallic gauges, the simplicity of the associated circuitry usually more than balances the price difference and this inherent simplicity results in little or no maintenance costs.

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A simple method of measuring the attenuation of coaxial cables

By B. F. D. Steger-Lewis,* B.Sc., Grad.I.E.E., A.K.C.

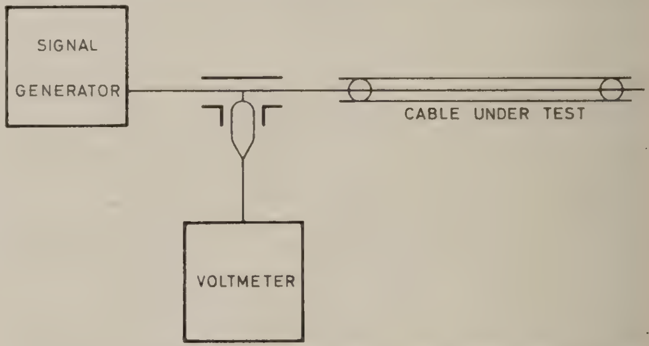
When the parameters of coaxial cables are considered, the most usually required constants are propagation coefficient, velocity ratio and characteristic impedance. There are, however, cases where the most important parameter to be measured is the attenuation per unit length (usually quoted in dB per 100 feet).

If sufficient of the line constants are known, this last parameter may be calculated, but it is often easier and more convenient to measure the attenuation directly.

The classical method of making this measurement uses a slotted line, but this is a tedious and complicated procedure, and the following details show how the measurement may be carried out using only a signal generator and a vacuum tube voltmeter capable of measuring A.C. voltage at the desired frequency.

The equipment is set up as shown in the figure and the signal generator output frequency is adjusted to give a maximum reading V(max) on the voltmeter, at a frequency as close as possible to the nominal test frequency.

The signal generator frequency is then re-adjusted through the nominal test frequency to give a minimum reading, V(min) on the voltmeter, again as close as possible to the nominal test frequency.



If the coaxial line is long compared with the wavelength at which the measurement is made, then the attenuation is given by

$$Al + 10 \log_{10} \frac{V(max) + V(min)}{V(max) - V(min)} \text{ dB}$$

Where A = attenuation coefficient
and l = length of cable.

Limitations of length of line and frequency:
It can also be shown that the percentage change in frequency required to take the voltmeter reading from a maximum to a minimum is given by:—

$$\text{Change in frequency} = \frac{v}{2lf} \times 100 \text{ per cent}$$

Where v = velocity of propagation
l = length of line
and f = frequency.

As the frequency is usually decided by other considerations, it would appear that the longer the line the better, as the percentage change in frequency should not be excessive. However, as the attenuation increases with the length of the line, V(max) approaches V(min) and the effect of a small error in either of these measurements will result in large errors in the final answer. Thus a compromise must be achieved in which the change of frequency must not be too large, or the difference between V(max) and V(min) too small.

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* An abridged version of an article prepared by Marconi Instruments Ltd.

Magnetic Heads

by Rocky James *

The magnetic-tape recorder of today is one of the most complex pieces of instrumentation equipment ever developed. Here in one device is combined the advanced technology of magnetics, electronics, and mechanics, blended to produce one precision instrument capable of continuous operation under the most exacting conditions.

No longer is the tape recorder an audio device with limited application. It has graduated to the level of being an essential part of every telemetry, data processing, digital, and analogue instrumentation facility. This change has come about largely because of the advanced development of one element without which there would be no magnetic-tape recorder — the magnetic head.

Why consider the magnetic head so vital? Because as we study the tape recorder, we find that the sole purpose of the tape transport is to pass the tape by the heads in a precise, smooth motion . . . and that the electronics serve to condition the signal for presentation to the record head and then to extract this recorded signal from the reproduce head and amplify it for transmission to subsequent data handling equipment. Without the magnetic head there would be no magnetic-tape recorder as we know it today. Modern magnetic-head technology and the improvements in magnetic tape have primarily been responsible for the unqualified acceptance of magnetic-tape recorders by the industry.

The importance of magnetic heads to the success of a tape recorder is exemplified by the fact that all major tape-recorder manufacturers maintain their own head department in order to assure proper performance and delivery. In fact, the most closely guarded secret of data-recorder manufacturers is their magnetic-head technology. It is significant to note that any advancement in recorded bandwidth is accompanied by the development of a new, improved magnetic head.

In order to better understand this valuable transducer, the following discussion briefly acquaints the reader with the magnetic head, some of its idiosyncrasies, and where we might expect the industry to go in the near future.

How Does It Work

The magnetic head is in essence a transducer that converts electrical signals into magnetic lines of force or vice versa. Figure 1 shows the basic configuration of a typical magnetic-tape record head. The electrical current flowing in the record head coil creates a magnetic field in the pole piece, which at the point of the gap fringes out from the pole piece and enters the medium of the magnetic tape where the signal characteristics are stored for later reproduction.

If the signal stored on the tape is to be a true representation of the record signal, then all the information regarding frequency amplitude and phase must be converted with true fidelity into the proper magnetic flux. The term "constant flux" recording has been used to describe the desired results.

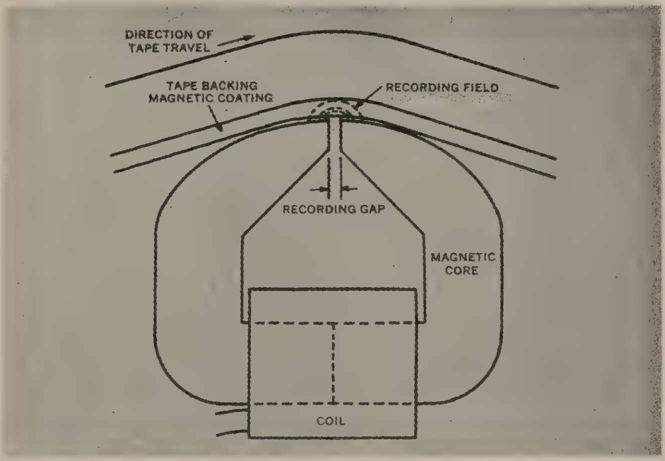

Figure 1. Relationship between tape and head gap.

With constant flux recording, any signal, regardless of frequency (within the pass band), will be translated into proprotional flux. To achieve this may require some high-frequency boost or pre-emphasis. Constant flux recording is not to be confused with "constant current" recording, which merely assures that the current entering the head is uniform with frequency. At wide bandwidths a vast difference may exist between the current entering the head and the recorded flux due to head losses and tape-to-head contact.

The reproduce process is similar to that employed by vibration pickup, phonograph pickups, etc., where the excitation source induces a current in the pickup coil. For the magnetic-tape recorder, the excitation is the residual flux contained within the tape. As the tape is passed by the reproduce head a voltage is generated which follows the formula $e = \frac{d\phi}{dt} = -2\pi Af \cos \omega t$.

This formula shows that the signal developed in the magnetic head is a function of the rate of change of flux induced in the head.

If the above formula were strictly true, then a tape recorder would be capable of extremely high frequency performance. Unfortunately, however, there are numerous other factors which limit the high end response. Several of these factors will be discussed later in the article and are shown in Figure 3. A typical audio reproduce head has an output level on the order of 10 millivolts (wideband heads are considerably less) which explains why amplifiers were necessary to the successful development of the magnetic recorder.

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* Data Instruments Division,
Consolidated Electrodynamics

Because of this, low-level noise pickup is a serious limitation of wideband recorders and special manufacturing techniques are used to minimize this problem.

The record head has the problem of handling the high-frequency bias which is essential for low-distortion direct recording. This frequency is normally at least three times the upper recorded bandwidth, which requires that a record head for a two-megacycle recorder must handle a bias frequency of from 7 to 10 megacycles. The bias frequency is beyond the response characteristic of the reproduce head and, therefore, does not enter into the reproduce head design considerations. The record head handles signals in the high millivolt level, whereas the reproduce head must process signals as low as one or two microvolts. These and other factors discussed later reveal why the design of modern magnetic heads is a complex process requiring careful engineering and precise manufacturing.

The parameters involved in designing record heads are so significantly different from those used in the design of reproduce heads that separate heads are always used in high-performance systems.

The complex phenomena of magnetic recording is far too involved to include in a brief article. However detailed discussion may be found in the references noted at the end of the article for anyone interested in pursuing this intriguing subject.

Design Complications

The development of the magnetic head has progressed to such a refined state that further improvements in performance present quite a challenge to the designers. Also, the variable design parameters are so numerous in the design of a magnetic head that it is not surprising to find among major manufacturers wide variations in construction, materials used, and electrical characteristics. Certain of these performance parameters are of primary concern to the magnetic-tape recorder user as they affect maximum bandwidth, SNR, and life. It is these parameters which will be discussed.

The shape of a magnetic head is one where a great deal of flexibility is possible. Factors that influence its shape are materials used, contour effect, and the frequency band of interest. Many of the new magnetic materials which are desirable for improved performance are difficult to machine and, therefore, a compromise in geometry must be made in order to realize the better performance.

One manufacturer has spent considerable effort to develop a properly shaped head while still utilizing one of the superior magnetic materials. Contour effect (undulations in the low-frequency response of the head) occurs when the recorded wavelength becomes comparable with the outside dimensions of the magnetic core. This is usually minimized by increasing these dimensions until the frequency at which it occurs is below the passband. Variations in the solutions used to solve the problem of contour effect contribute to a variety of the head shapes encountered.

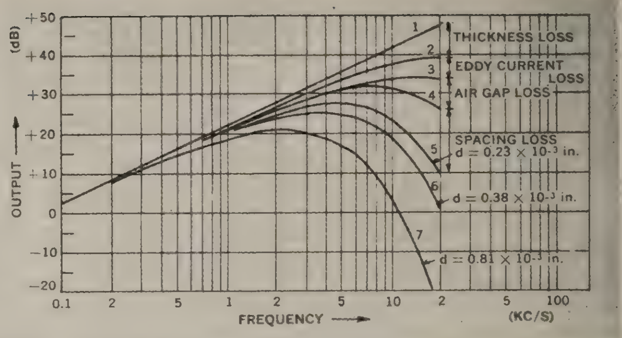

Figure 2. Frequency response curves showing division of playback losses.

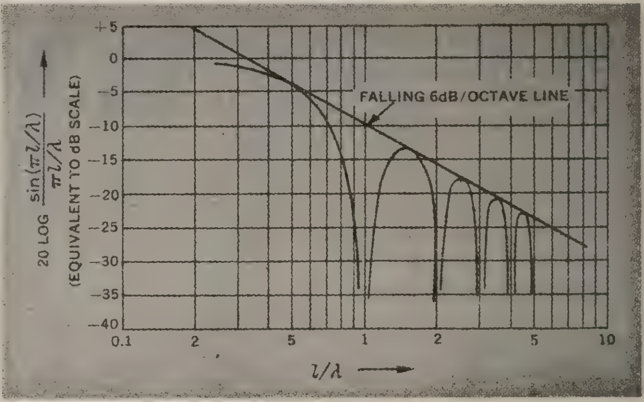

Figure 3. Successive maxima and minima due to airgap effect.

One of the most critical of all head parameters is gap depth, which affects upper-frequency limit and life. A thinner gap provides improved high-frequency output while simultaneously reducing head life. The width of the gap is most significant in limiting high-frequency response. As the recorded wavelength approaches the width of the gap, the output signal approaches zero. (See Figure 3). For example, a 2.0 mc signal recorded at 120 ips presents a wavelength of 60 micro-inches to the head. Present manufacturing techniques are capable of providing a gap width of 30 micro-inches or better. However, magnetic-tape quality is presently the limiting factor with particle sizes around 40 micro-inches.

Laminated head construction has long been the standard technique in the manufacturing of heads in order to reduce eddy current losses. Recently, since better materials are available, solid, all-metal pole pieces are becoming widely accepted since they provide superior output and improved life. The all-metal surface wears more evenly than laminated structures and, therefore, does not develop any jagged grooves to scrape oxide from the tape. Also, the even wear exhibited by the all-metal surface provides optimum head performance for its entire life.

The high performance multi-track heads of today require manufacturing techniques that would put a watchmaker to shame. Exact environmental conditions are maintained in today's clean rooms at all times. Precision optical microscopes are required for accurate assembly of the heads to assure proper spacing and alignment of the various tracks in the head. Azimuth misalignment of only 10 minutes will cause a 12 db loss at 70 kc at 60 ips. Precise manufacturing techniques are required to maintain superior performance.

Aside from careful design and manufacturing, the magnetic head requires proper care to ensure top performance. Proper care for the average user requires occasional degaussing and regular cleaning. Degaussing is required to overcome the residual d-c magnetization of the head which accumulates as a result of the passage of the magnetic tape over the pole, and as a result of electrical switching transients. This accumulated magnetization results in a decrease in the overall system signal-to-noise ratio because of the resultant background noise and, more important in many cases, increases the even harmonic content of the recorded signal.

Cleaning of the heads is required (recommendations are contained in O & M manuals supplied by most manufacturers) to remove accumulated oxide dust. Cleanliness is important especially in high-frequency work to reduce spacing losses which result from the tape being other than in direct contact with the head. An example of the seriousness of this loss is to consider a recorded signal of 1 mc at 120 ips. A space between tape and heads of only 24 micro-inches will result in a 10 db signal loss.

Compare this to the particle size of present magnetic tape, which is 40 micro-inches, and it can be seen that dirt accumulated on the tape can cause severe decrease in signal output at high frequencies. Tape cleaners are available from some manufacturers to reduce losses caused by dirty tape. Basically, all of these manufacturers set out to clean the tape before entering and after leaving the head area to eliminate any dirt or oxide dust from being pressed into the tape when tape is packed onto the takeup reel. For example, one employs a combination of ion bombardment, vacuum, and jaguar brushes to assure a thorough cleaning job.

The purchaser of a magnetic-tape recorder has no control over the heads he gets with the recorder as all manufacturers provide these as an integral part of the system for reasons discussed earlier. However, the quality of a head, the manufacturer's production techniques, and customer comments as to head life are worth considering and should not be passed over when evaluating the right recorder for a particular job.

Recording Limitations

Have we reached the limit in longitudinal recording utilizing present methods? This is a feeling expressed by many engineers and scientists involved with looking toward 10 mc and greater recording bandwidth. Certainly if we look at the progress attained by magnetic-head and tape technology in the past 20 years, it seems short-sighted indeed to say that we are approaching the limit. Magnetic heads using existing technology are presently in evaluation of 2.0 mc and on the drawing boards for 5 mc. Multi-track heads are presently in production for 32 tracks to the inch and preliminary studies have been completed for 42 tracks to the inch.

What then is the theoretical limit? As long as individual magnetic particles can be selectively magnetized and then retrieved by the desired channel, there is no theoretical limit to the channels-per-inch of tape or the upper recorded frequency. However, before the state-of-the-art can be pushed much beyond the present 2.0 mc @ 120 ips and 32 channels-per-inch, improved performance will be required from all areas of magnetic-tape recorder technology, the magnetic heads, electronics, magnetic tape, and the transport.

Track density presently is limited because as the number of tracks increases, the width of the recorded track decreases and the resultant output from the tape is proportionately lower at the reproduce head. Also, shielding between channels becomes more difficult and transport skew has an added effect. However, improved efficiency heads with integral micro-electronic preamps will enable better shielding so that track spacing may be reduced to values approaching the particle size on present-day magnetic tape. Theoretically then, there is no foreseeable limit to the number of tracks per inch of tape. A break-through in magnetic materials, transport design, and head construction will be necessary before any appreciable step forward is taken in this direction.

The factor of more immediate concern to magnetic-tape recorder users is upper-frequency limit. The upper limit may be extended utilizing present designs merely by running the tape at faster speeds. Each time the speed is doubled the upper limit is doubled (assuming electronics and heads are designed to handle the higher frequencies . The obvious sacrifice here is tape usage, for each time the speed is doubled, tape consumption is doubled. The problem posed to the designer engineer then is how to increase frequency without increasing speed.

A significant factor in the upper limit for a magnetic head is the gap width, because as the recorded wavelength reaches the same dimension as the gap width, the signal out from the reproduce head falls to zero. As shown previously, the logical conclusion is to make the gap width as small as possible. However, as the gap width is reduced, signal output is reduced and construction becomes extremely difficult. Therefore, once again considerable break-through in materials and manufacturing techniques will be required before a significant step forward can be made.

However, to say that magnetic-tape recording is reaching the limit in its performance is ignoring the capabilities of today's scientists and engineers who are devoutly engaged in producing better materials, better transports, and more sophisticated head designs.

The magnetic head as the heart of modern tape recorders will continue to function in its role as the transducer converting electrical signals to magnetic flux and back again as long as the state-of-the-art is advanced. Magnetic-tape recording today is as challenging a field as one can find anywhere. The horizons are broad and the future is unlimited.

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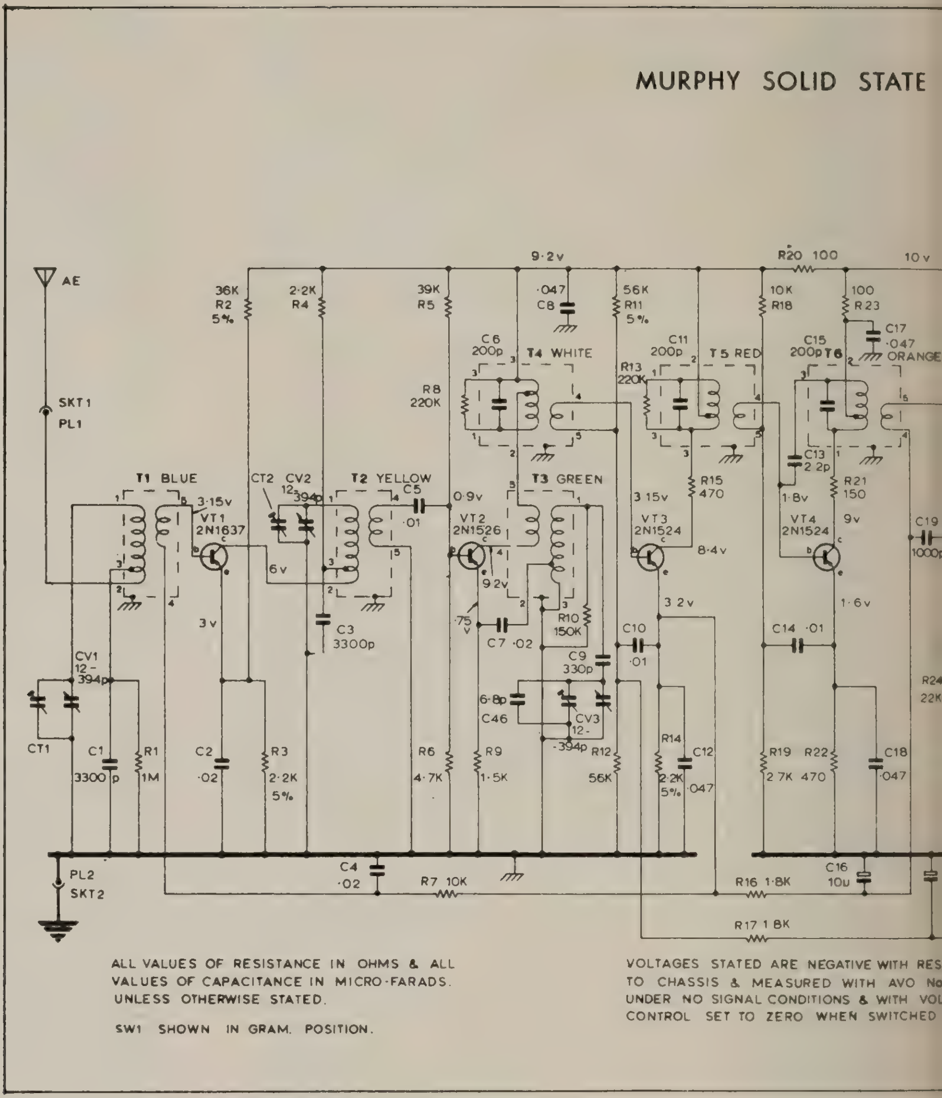
2. Magnetic Recording Techniques—Stewart.
3. Magnetic Tape Recording—H.G.M. Spratt.
4. A New Model for Magnetic Recording—B. B. Bauer, IRE, Transactions AU 9-10; Sept.-Oct. 1961, pg. 139.
5. The Effect of Track Width in Magnetic Recording—D. F. Eldridge, IRE Transactions AU 9-10; Jan.-Feb. 1961, pg. 10.
6. A Magnetic Head for the Megacycle Range—Otto Kornei, IRE Nat'l. Convention Record; 1965 PT 5.

MURPHY
Solid State Stereograms

Model Nos. SG 12-28 & SG 12-29

Circuit and Service Data

MURPHY SOLID STATE



ALL VALUES OF RESISTANCE IN OHMS & ALL VALUES OF CAPACITANCE IN MICRO-FARADS. UNLESS OTHERWISE STATED.

SW1 SHOWN IN GRAM. POSITION.

VOLTAGES STATED ARE NEGATIVE WITH RES TO CHASSIS & MEASURED WITH AVO No UNDER NO SIGNAL CONDITIONS & WITH VOL CONTROL SET TO ZERO WHEN SWITCHED

CHASSIS REMOVAL:
SG12-28

1. Remove the control knobs by pulling straight up.
2. Disconnect the aerial lead, pickup leads, speaker leads, and gram unit mains and earth leads.
3. Unclip the bezel lamp from its support bracket.
4. Remove the four 4BA nuts holding the dial reflector plate.
5. The chassis can now be removed from the cabinet for service work.

SG12-29

1. Remove the control knobs by pulling straight off.
2. Disconnect the aerial lead, pickup leads, speaker leads, and the gram unit mains and earth leads.
3. Remove the six 4BA nuts holding the dial reflector plate.
4. The chassis can now be removed from the cabinet for service work.
5. Before replacing the chassis ensure that the six angled scale retaining brackets are in place.

ALIGNMENT INSTRUMENTS

1. **EQUIPMENT REQUIRED**
   - a A signal generator covering the range of 450 Kc/s to 1.5Mc/s modulated 30% at 400 or 1000c/s.
   - b. An audio output meter capable of reading 500MW @ 15 ohm e.g. a Multimeter on the 10V A.C. range will indicate a power output of 500 MW when the voltage reads 2.74 across a 15 ohm speaker.
   - c. A non-metallic trimming tool suitable for adjusting the I.F. and R.F. coils.
   - d. A 100pf dummy aerial.

   CAUTION:

   Do not screw the I.F. & R.F. cores hard down at the bottom of their travel as this may cause the coil bottom to crack.
2. **I.F. ALIGNMENT**
   - a. Set the signal generator to 455 Kc/s. Disconnect the .01ufd. convertor base coupling capacitor and couple the output from the signal generator through a .1ufd capacitor into the base of the convertor. Stop the local

NOTES, ADDRESSES, PHONE NUMBERS

This conference, the first of its kind in the electronics field, has grown far beyond the fondest hopes of the organisers when the venture was first discussed some eight or nine months ago. The expected enrolments now appear certain to be in excess of three hundred people to whom seventy-nine papers are being presented. A great deal has been learnt which will be invaluable in the planning of the next conference and it is certain that much additional information will be obtained during these three days.

The timetable of papers and venues is set out on the next six pages in a form that enables people to assess which papers are being presented in any given stream at any particular time. Except in two instances it has been possible to keep each stream in the same lecture theatre throughout and the lecture rooms have been chosen to provide ample seating in all streams.

If visitors require any assistance, or wish to make contact with any particular person it is suggested this be done through the conference enrolment and information office situated in the men's common-room in the University.

SOCIAL — Thursday at 8.00 p.m. at Auckland Technical Institute — tickets are obtainable from the information centre.

PREPRINTS — Enquiries concerning preprints should also be made at the information centre.

The provisional list of firms and organisations exhibiting during the Conference is :

Watson Victor Ltd.
Sample Electronics (N.Z.) Ltd.
W. G. Leatham Ltd.
Pye Ltd. (Telecommunications Division)
Concord Electronics Ltd.
Electric Control & Engineering Ltd.
Electronic Navigation Ltd.
Geo. W. Wilton Ltd.
W. & K. McLean Ltd.
EDAC Ltd.
Plessey (N.Z.) Ltd.
Redfern Radio
Technical Services Ltd.
Amalgamated Wireless Australasia (N.Z.) Ltd.
Naval Research Laboratory
Physics and Engineering Laboratory, D.S.I.R.
R.N.Z.A.F.
H.M.N.Z. Dockyard, Devonport.

WEDNESDAY, 17th AUGUST

8.00-9.00 ENROLMENT

9.00-9.45 OPENING

9.45-10.00 Education & electronics.
J. K. Hunn, Chairman of NERC.

10.00-10.30 MORNING TEA

	Section A: Data Handling Chairman: Mr. J. Robertson Lecture Room: Upper Lecture Theatre	Section B: Modern Communications Chairman: Mr. D. P. Joseph Lecture Room: Lower Lecture Theatre	Section H: Electronics Education Chairman: Mr. J. K. Hunn Lecture Room: Main Hall	
10.30-11.00			Automation & education. R. J. McBeath, Post Primary Teachers' College, Auckland.	
11.00-11.30			Recent developments in electronic education overseas. I. Turner, A.T.I.	
11.30-12.00			Electronics in N.Z. Universities. R. J. Clegg, Physics Dept. UoA.	
12.00-12.30			Discussion Panel — "The electronics engineer and the technician". B. H. Olsson, NRL, R. B. Waddell, A.T.I., G. M. Beere, RNZN.	
12.30-1.30	LUNCH			
1.45-2.15	The use of thermistors for measurement of thermal microstructure. M. J. Bowman, Physics Dept., UoA.	Reliability as an administrative problem. J. E. A. Nixon, Physics Dept., VUW.		A portable alpha counter for measuring very low levels of activity in food, tobacco, etc. F. H. Ellis & R. A. Morris, PEL, D.R.I.R., Lower Hutt. LLT.
2.20-2.50	A spectrographic receiver for V.L.F. transmissions. G. L. Jones, R. A. Morris and N. R. Poletti, PEL, D.S.I.R., Lower Hutt.	Non-destructive testing. S. D. Mandeno, Sonophone Distributors Ltd., Auckland.	A portable integrating omni-directional anemometer. R. A. Morris, A. R. Morman & D. Scott, PEL and Plant Physiology Div., D.S.I.R., Lower Hutt.	
2.55-3.25	A parametric amplifier for use at sub-audible frequencies. J. H. Buckingham, PEL, D.S.I.R., Lower Hutt.	Power control using silicon controlled rectifiers in an environmental control application with a switching capacity of 0.5 megawatt. W. P. Gabriel, R. A. Morris & R. W. Robotham, PEL and Plant Physiology Div., D.S.I.R., Lower Hutt and Palm. Nth.	A daylight integrator. R. A. Morris & R. W. Robotham, PEL and Plant Physiology Div., D.S.I.R., Lower Hutt and Palmerston North.	
3.25-3.45	AFTERNOON TEA			
3.45-4.15	The design and use of distributed R.C. filters. K. J. Gough, VUW.	Mobile communication equipment — development of a modular family of equipments. A. M. Tait & A. Adams, A. M. Tait Ltd., Christchurch.		Nuclear electronics at the University of Auckland. I. J. Walker, Physics Dept., UoA. (Lower Lecture Theatre)
4.20-4.50	Equipment to measure elastic moduli and internal friction in rods. R. E. Booker, Physics Dept., UoA.	Railway signalling — electronic remote control. R. B. McCorkindale, NZR, Wellington.		Control systems for van der Graaf voltage generators. B. A. McKinnon & R. U. M. Gummer, Physics Dept., UoA. (Lower Lecture Theatre)
4.55-5.25	The operation of VHF & UHF transistors at frequencies approaching and beyond their cut-off frequencies. I. H. Spackman, Chemistry Dept., UoA.	An 18 camera C.C.T.V. installation for surveillance in a security establishment. T. G. Proctor, M.O.W., Wanganui.		A developmental scaler timer for radiochemical laboratories. A. Ross, Chemistry Dept., UoA. (Lower Lecture Theatre)

FRIDAY, 19th AUGUST

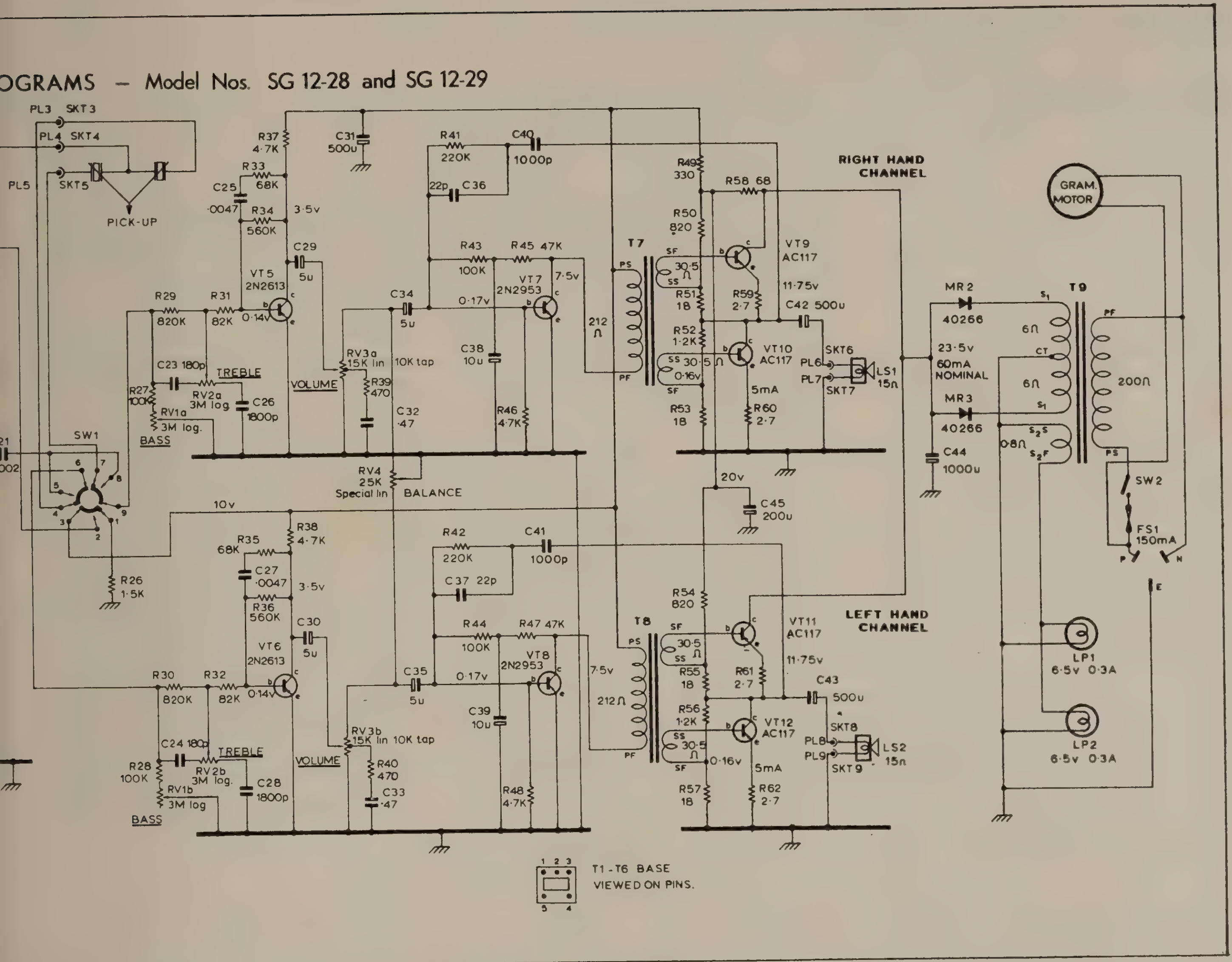
TIME	Section C: Research Electronics Chairman: Prof. A. G. Bogle Lecture Room: Upper Lecture Theatre	Section D: Industrial Electronics Chairman: Mr. E. H. Parfitt Lecture Room: Physics No. 2	Section E: Medical Electronics Chairman: Mr. A. W. Melville Lecture Room: Lower Lecture Theatre	Section G: Nucleonics Chairman: Prof. E. R. Collins Lecture Room: Physics No. 2 and Lower Lecture Theatre
9.00-9.30	Some applications of semi-conductors in the chemical laboratory. J. K. Johannesson, A.T.I.		A central recording system for medical research. A. T. Wallis, Wellcome Med. Res. Inst., Dunedin.	
9.35-10.05	The resonance probe — A new plasma diagnostic tool. R. P. McGann, Physics Dept., UoA.		Intensive care monitoring of patients following heart-lung by-pass surgery. G. C. Rust, Physiology Dept., Greenlane Hospital, Auck.	
10.10-10.40	Measurement of noise in hydrophone amplifiers. J. M. Tricker, NRL, Auckland.		Blood pressure recorder for use in decompression chambers. J. P. Senior, Magnetic Observatory, D.S.I.R., Christchurch.	
10.40-11.00	MORNING TEA			
11.00-11.30	A 40 mhz solid state total power radiometer. B. Egan, G. A. Moyle & J. R. Irving, School of Eng., UoA.		A foetal pulse rate monitor. J. B. Cornwall, AIDD.	The cosmic ray observatory at Gracefield. K. J. Gough, Inst. of Nuc. Sc., D.S.I.R., Lower Hutt. (Physics No. 2.)
11.35-12.05	A broad band antenna array for low frequency radio astronomy observations. B. Egan, J. C. Lim, B. K. Wee & A. Thorley, School of Eng., UoA.		A child-proof hearing aid. C. W. Salmon, National Audiology Centre, Health Dept., Auckland.	General purpose logarithmic & linear count rate meters. A. Ross, Chemistry Dept., UoA. (Physics No. 2.)
12.10-12.40	A proton precision magnetometer. J. P. Senior, Magnetic Observatory, DSIR, Christchurch.		The use of linear displacement transducer to record the motility of partial exteriorizations of the stomach in sheep and cows. D. W. Webster, APS, Pl. Chem Div., D.S.I.R.	Electronic equipment in radiocarbon dating. H. S. Jansen, Inst. of Nuc. Sc., D.S.I.R., Lower Hutt. (Physics No. 2.)
12.40-1.45	LUNCH			
1.30-2.00	Data transmission and the communication network. R. B. Wilkinson, NZPO, Wellington.	Semi-conductor diode application in modern communications. D. A. H. Johnson, Electrical Engineering Dept., UoC.	Discussion panel — "The training of electronics technicians." Double session. F. Stephens, Wellington Polytechnic College, M. Jillings, A.T.I. Physics No. 2.	
2.05-2.35	Digital data telemetry. E. R. Grant & A. M. Tait, A. M. Tait Ltd., Christchurch.			
2.40-3.10	Peripheral equipment for digital computers. A. E. J. Pitchforth, Armstrong & Springhall, Wellington.	Colour television systems. P. E. Rollo & P. Mainwaring, NZBC, Wellington.	Training technical staff for telecommunications div., DCA. O. W. Martin, DCA. Physics No. 2.	
3.10-3.30	AFTERNOON TEA			
3.30-4.00	Data acquisition facilities for nuclear physics research at the Institute of Nuclear Sciences. K. A. Bargh & G. J. McCallum, Inst. of Nuc. Sc., Lower Hutt.	Television receiver circuitry developments. J. Howe, EDAC Ltd., Auckland. (Slade Memorial lecture).	Research at University of Canterbury. Prof. L. Kay, Electrical Engineering Dept., UoC. Physics No. 2.	
4.05-4.35	Tape punch equipment for the automatic recording of data. M. J. Beale and R. A. Morris, PEL, Lower Hutt.	Design & development of a television tuner to suit N.Z. conditions. K. A. Tribble, AKRAD Radio Corp., Waihi.	The admittance matrix: A universal approach to active circuit analysis. B. Egan, School of Engineering, UoA. Physics No. 2.	
4.40-5.10	A data recording system with independent channel control. M. D. Johns, Physics Dept., UoA.	The history and advanced development of studio television cameras. R. B. Gordine, AWA (A'sia) N.Z. Ltd., Wellington.		
8.00 p.m.	Discussion led by Cdr G. Beere (RNZN). The National Electronics Research Council: Relations between industry and government research departments. ULT.			

Abbreviations used in this list:

APS	Animal Physiology Section.
AWA	Amalgamated Wireless A'sia (NZ) Ltd.
AIDD	Auckland Industrial Development Division, D.S.I.R.
ATI	Auckland Technical Institute.
DCA	Dept. of Civil Aviation
EDAC	Electronic Development & Applications Co. Ltd.
Inst. of Nuc. Sc.	Institute of Nuclear Science.
NRL	Naval Research Laboratory.
MOW	Ministry of Works.
NZBC	New Zealand Broadcasting Corporation.
NZPO	N.Z. Post Office.
NZR	N.Z. Railways.
PEL	Physics and Engineering Laboratory, D.S.I.R.
Pl. Chem. Div.	Plant Chemistry Division.
UoA	University of Auckland.
UoC	University of Canterbury.
VUW	Victoria University of Wellington.

THURSDAY, 18th AUGUST

TIME	Section A: Data Handling Chairman: Mr. J. Robertson Lecture Room: Upper Lecture Theatre	Section B: Modern Communications Chairman: Mr. D. P. Joseph Lecture Room: Lower Lecture Theatre	Section D: Industrial Electronics Chairman: Mr. E. H. Parfitt Lecture Room: Physics No. 2	Section F: Electronics in Aviation Chairman: Wing Cdr J. P. Conyers Brown Lecture Room: Physics No. 2
9.00-9.30	Applications of digital computers in science & engineering. E. W. Jones, Applied Mathematics Div., D.S.I.R., Wellington.	Multi-channel telephony on broadband bearers. W. T. Lack, NZPO, Wellington.		
9.35-10.05	The effect of solid state devices on analogue computing. B. L. Fulford, E.A.I. Electronic Associates Pty., Australia.	Submarine cable links and the compac system. A. D. Gifkins, NZPO, Auckland.		
10.10-10.40	An automatic acoustic ray tracing computer. L. D. Light, NRL, Auckland.	Some aspects of system planning of earth stations. H. G. Arthur, NZPO, Wellington.		
10.40-11.00	MORNING TEA			
11.00-11.30	Low cost digital computing for engineers. R. A. Cookes, E.A.I. Electronic Associates Pty., Australia.	Waveguide practices in N.Z. Post Office microwave stations. R. Motion, NZPO, Wellington.		
11.35-12.05	Integrated circuit components. D. J. Barnes, NRL, Auckland.	Electronic telephone exchanges. G. T. McPherson, NZPO, Wellington.		Flight testing of aircraft electrical systems. G. E. Jones, NRL, Auckland.
12.10-12.40		A miniature V.H.F. radiotelephone. R. A. Pannet, AKRAD Radio Corp., Waihi.		The low approach mode of instrument landing — autopilot and flight directors. B. Taylor, Air New Zealand. The low approach mode of instrument landing — radio navigation aspects. W. Keen & E. Symmons, Air New Zealand.
12.40-1.45	LUNCH			
1.45-2.15	Switching characteristics and digital applications of tunnel diodes. J. B. Earnshaw, Physics Dept., UoA.	Frequency engineering for VHF mobile services. R. Cassey, NZPO, Wellington.		
2.20-2.50	Transient characteristics of series connected tunnel diodes. Z. C. Tan & J. B. Earnshaw, Physics Dept., UoA.	An integrated VHF & UHF communications & telemetry bearer system. P. H. Bingley & K. Shankland, Pye (Telecommunications) Ltd.		A precise digital intervalometer for aerial photography. W. P. Gabriel & R. A. Morris, PEL, D.S.I.R., Lower Hutt.
2.55-3.25	A transistor-diode feedback type logic circuit. P. M. Fenwick & J. B. Earnshaw, Physics Dept., UoA.	V.L.F. radio propagation investigations in New Zealand. G. J. Burtt, PEL, D.S.I.R., Lower Hutt.		Airborne communications from sail planes. P. A. G. Howell, Physics Dept., UoC.
3.25-3.45	AFTERNOON TEA			
3.45-4.15	Data reduction for a large antenna system. B. W. Hicks, Physics Dept., UoA.	A tunable phase-locking V.L.F. receiver. R. A. Morris & N. R. Poletti, PEL, D.S.I.R., Lower Hutt.	Profile milling by programmed numerical control. M. J. Beale, S. Lattimore, W. P. Gabriel & R. A. Morris, PEL, D.S.I.R., Lower Hutt.	
4.20-4.50	A new system for the digital setting of temperature and humidity controllers. W. P. Gabriel, R. A. Morris and R. W. Robotham, PEL and Plant Physiology Div., D.S.I.R., Lower Hutt and Palmerston North.	A novel frequency synthesiser with multiple outputs. I. R. Richards & R. A. Morris, PEL, D.S.I.R., Lower Hutt.	The oscilloscope-versatility in instrumentation. P. Williams, Tektronix Pty. Ltd., Australia.	
4.55-5.25	Application of computers to electronic circuit design. D. J. Byers & H. J. Jelinek, Electrical Eng. Dept., UoC.	Precision frequency and time standards. L. S. Spackman, Auckland. (To be followed by a Panel Discussion on Frequency Standards in N.Z.).	Electronic weighing. B. Pidgeon, EDAC Ltd., Wellington.	
8.00 p.m.	SOCIAL FUNCTION at Auckland Technical Institute, Wellesley Street.			


OGRAMS — Model Nos. SG 12-28 and SG 12-29

oscillator by shorting the oscillator trimmer to ground.

b. With the balance control at approx. mid-position and the volume control at maximum, peak T6, T5 and T4, and in that order, for maximum output, adjusting the attenuator to keep the output at approx. 500MW or less.

c. The final response is achieved by stagger tuning T4 and T5 to give a —6db bandwith of 10 Kc/s. T4 is tuned to 457 Kc/s and T5 to 453 Kc/s and symmetry of response is adjusted by T6.

RF ALIGNMENT

NOTE:

Check that the aerial coil, RF coil, and oscillator coil gang leads are well separated before commencing RF alignment. The calibration markers are the long vertical lines stamped on the dial reflector and are from right to left;

Datum — 600 Kc/s — 1000 Kc/s — 1364 Kc/s — 1500 Kc/s.

a. Connect the signal generator, through a 100pf dummy aerial, to the aerial and earth terminals on the printed board.

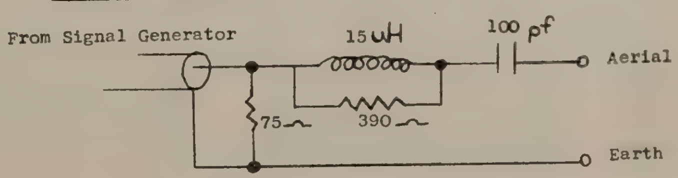
b. Close the gang and set the pointer to the gang closed datum mark on the dial reflector.

c. Tune the pointer to the 600 Kc/s calibration mark and peak oscillator, RF and aerial coil slugs for maximum output, adjusting the attenuator on the signal generator to keep the audio output at 500MW or less.

d. Tune the pointer to the 1500 Kc/s calibration mark and peak the oscillator, RF and aerial coil **trimmers** for maximum, keeping the audio output level at 500MW or less.

e. Repeat steps (c & (d) until no further improvement in output is obtained.

100pf DUMMY AERIAL



SERVICEMAN'S COLUMN

by J. WHITLEY STOKES

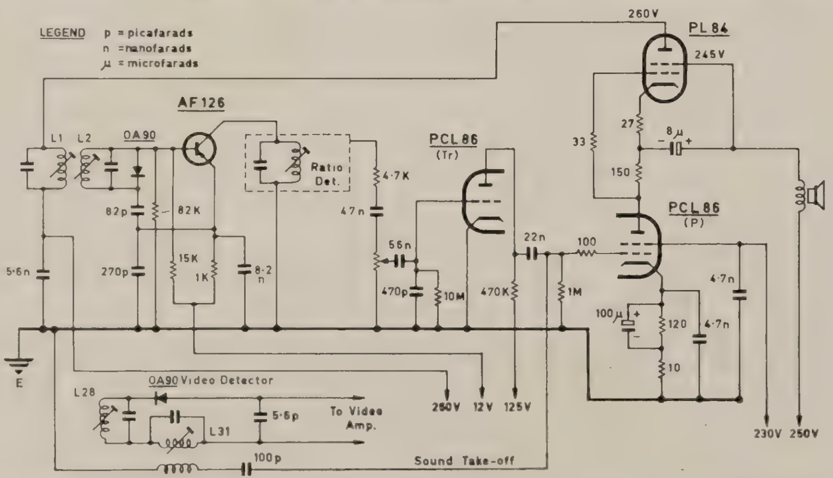
In that transistors have begun to make their appearance in locally produced TV receivers perhaps a few words on the subject may not be amiss. Even readers not engaged in the servicing business may be interested in learning a few details of current practice.

Although the advertising boys have been quick to seize on the magic word 'transistorised' the plain fact is in one case the inclusion of a single transistor alone justifies the use of this term. In another case the two transistors allow the claim 'hybrid' to be used. Under the circumstances perhaps one may be pardoned for wondering whether there is any sound technical reason for including one or two transistors in an otherwise all valve design.

In the accompanying diagram which illustrates the sound section of one new model, it will be noticed the use of a transistor in the sound I.F. section is only one new departure. This other feature, which is in itself not a new development but rather the recent application of a very old technique, goes back to the early beginnings of radio. Servicemen will be interested (or horrified?) to see that the ancient and supposedly long dead and buried technique of reflex amplification has been resurrected and employed in connection with the sound section. In this case there is no connection between the use of a transistor and the use of reflex amplification as the transistorised stage operates as a straight amplifier.

If I may digress for a moment I think I am echoing the thoughts of most servicemen when I say that if there was one feature encountered in radio receiver design which incurred universal damnation it was reflexing. Although it was used by one N.Z. manufacturer, reflexing never became popular in this country even though it was widely employed in Australia in the late thirties. At this time reflex amplification was used as an economy measure to produce a cheap 4 valve receiver with the normal I.F. stage doing double duty as an A.F. amplifier as well. For the historically minded it may be mentioned that the history of reflex amplification goes back long before the development of the superheterodyne principle. Some of the first commercially built receivers of the early twenties were of the reflex variety using valve amplifiers in conjunction with a crystal detector. These remarks have been included largely for the benefit of the younger generation who may otherwise be under the impression that reflexing is a new technique. As a corollary of this a word or two on "how it works" may be in order.

Referring to the diagram the starting point is the sound take-off at L31 which performs the usual dual function of sound trap to the video amp. grid and first sound I.F. transformer. Thence to the grid of the pentode section of the PCL86 sound output valve which forms one half of the single-ended push-pull output stage. This is where the fun starts for as can be seen the main function of the PCL86 in conjunction with the PL84 is that of an A.F. power amplifier. How then can they also handle the 5.5 Mc sound I.F. signal? Ignoring for the moment, the A.F. functioning of this stage and the loudspeaker connection we find the 5.5Mc signal together with audio appearing at the PL84 plate. Normally the unused A.F. at this point is by-passed by the electrolytic filter condenser in the power supply but in this case it is necessary to "save" the IF signal first. This is done by inserting the primary (L_1) of the



Circuit illustrates the sound section of new model which features a transistor in the sound I.F. section and also reflex amplification.

second sound I.F.T. in the plate circuit and due to the almost zero impedance of this coil to audio it has no effect on the A.F. functioning of the PL84. L2 forms the secondary of the I.F.T. which is coupled to the base of the AF126pnp transistor connected in conventional common emitter configuration.

The signal then passes on to a normal ratio detector after which it of course becomes audio frequency. Next via the volume control to the grid of the triode section of the PCL86 connected as a familiar grid leak biassed A.F. voltage amplifier stage. Now the signal arrives back at the point where it started off—the grid of the PCL86(P) — but nothing daunted continues on its merry way for a second time through the output stage, this time as A.F., and ends up as sound for the speaker. Briefly, the output stage performs the dual and simultaneous function of I.F. and A.F. amplification. Got it?

That it is able to do this is due to the wide separation in frequency between the two signals which allows circuit constants to be chosen which respond independently to the two different signals. Even so the overall gain is less than if two separate stages are used.

Seems I started off on 'transistorisation' but got side tracked, so now for a brief review of another model employing two transistors. In this case one transistor functions as the second stage of a two stage I.F. strip with the remaining transistor forming a single stage sound I.F. section coupled to a quadrature detector.

The above two models undoubtedly indicate the shape of things to come and it is likely that transistors will continue to be increasingly used in TV receivers just as they are now also making their appearance in new model stereograms.

LISTENING POST

by michael lawrence

A YOUNG AUSTRALIAN DX CLUB

Starting in December 1964 as the Sydney branch of the N.Z. Radio DX League, the Australian Radio DX Club became independent just over a year ago and has a membership which is gradually approaching 100.

The club caters for all types of DX — medium wave, shortwave, amateurs and utilities and a separate section is devoted to each of these in the impressive monthly magazine "Australian DX News" along with items of general interest to everybody. The copy sent to me contained 18 quarto size pages each containing information as good as can be found in any other club magazine.

As well as the magazine the club also compiles a DX programme called "World at Your Fingertips" which is broadcast over 3NE Wangaratta (1600 kc/s) at 1235 GMT on Sundays.

Annual subscription rates for the club are $A2 or NZ 16/- for surface mail postage of the magazine and $A3 or £NZ1/4/0 for airmail postage.

The address for the club is Australian Radio DX Club, P.O. Box E73, St. James, N.S.W., Australia.

STATION NEWS

NEW ZEALAND. The schedule of Radio New Zealand to become effective on 4th September is:— To Pacific Islands: 1700 - 1945 on 6080 and 9540; 2000 - 0545 on 11780; 0600 - 0845 on 6080 and 9540. To Australia: 2000 - 2230 on 9540; 2245 - 0545 on 15110; 0900 - 1145 on 6080 and 9620. To Antarctica on Sundays: 0815 - 0845 on 6080.

INDIA. After suffering some severe interference to 11905 for their transmission to Australia and N.Z. from 2045 - 2230, All India Radio have changed frequency to 11930. However, this channel experiences some interference and reception is usually fair - poor.

NORWAY. The trend towards greater usage of the higher frequencies with the increasing sunspot numbers (the June count was 46.4) is reflected in the schedule of Radio Norway which comes into use on the 1st October:—

To North America and the Pacific: 0300 - 0430 on 9550, 9610, 11850; To the Pacific and East Africa: 0745 - 0815 on 11850, 15175, 17825, 21670, 25900; To the Far East, Australia, New Zealand and Europe: 1100 - 1230 on 7240, 15175, 17825, 21670, 25900; To Eastern USA, South America, India, Indonesia and West Australia: 1300 - 1430 on 15175, 17825, 21670, 21730, 25900; To Greenland, North and Central America and Africa: 1500 - 1630 on 15175, 17825, 21670, 21730, 25900; To East Europe, Mediterranean, Africa and South America: 1700 - 1830 on 15175, 17825, 21670, 21730, 25900; To the Pacific, Africa and South America: 1900 - 2030 on 11850, 15175, 17825, 21670, 21730; To Eastern USA and South America: 2100 - 2230 on 11850, 15175, 17825; To Eastern USA, Central and South America: 2300 - 0030 on 9550, 9610, 11850.

SWEDEN. The Swedish National programme is transmitted over 100 kW transmitters to listeners in Europe, the Middle East, Far East, Africa and the Atlantic as follows: 0445 - 0900 and 1730 - 2130 on 6065; 0900 - 0930 and 1120 - 1215 on 9625.

FRANCE. Radiodiffusion-Television Francaise can currently be heard at 0600 on 9620 and 5960. At 0800 a programme can be heard on 9620.

GERMAN FEDERAL REPUBLIC. English language transmissions to Australia and New Zealand from Deutsche Welle can be heard as follows:— 0845 - 0945 on 17845, 15275 and 11905; 2110 - 2200 on 9685 and 7290.

U.S.A. The Voice of America beams the following English language transmissions to the Far East:— 1330 - 1630 on 5975; 0900 - 1530 on 5985; 0900 - 1630 on 7165; 0900 - 1130, 1200 - 1230, 1300 - 1330, 1400 - 1415, 1600 - 1630 on 9565; 1400 - 1630 on 9605 and 9615; 0900 - 1530 on 9665; 0900 - 1630 on 11735; 0900 - 1100 on 11775 and 11790; 1330 - 1630 on 11850; 0900 - 1230 on 15120 and 15130; 0900 - 1000 on 17820.

All times are in GMT and frequencies in kilocycles

Some Aspects of Transmission Lines for 432mhz

By I. Spackman. ZL1MO

Many U.H.F. workers have wanted to install an antenna at some distance from their equipment to endeavour to attain improved coverage. One of the main problems has been to find a transmission line which is not going to dissipate a large proportion of the power before it arrives at the aerial system.

On transmission this problem can be overcome to a certain extent, by increasing the power input to the transmitter, within practical limits. On reception, however, the signal energy which is lost, is not recoverable, and consequently the receiving system is degraded in sensitivity, and noise figure, by the attenuation of the transmission line. This problem can be overcome by the installation of some form of antenna pre-amplifier, but this also complicates matters because transmit-receive switching of the cable requires a relay and associated supply voltages to be provided at the antenna, both for relay and pre-amplifier.

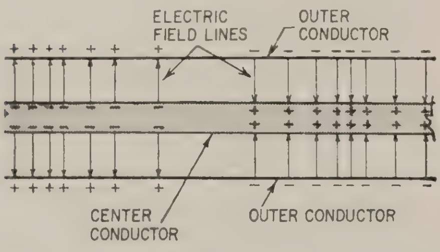


Figure 1
Pattern of charges and imaginary symbolic electric field lines on ordinary coaxial cable.

The attenuation factor of coaxial cable per 100 feet is quite significant. Typical figures for a good quality ½ inch diameter 70 ohm solid dielectric cable are in the vicinity of 5 dB. per 100 feet, at 432 mhz., when new, and if the line is correctly matched. This is possibly the only disadvantage of such cable as it generally is quite rugged, both electrically and mechanically. It will stand the ravages of weather well if correctly installed, and can be allowed to lie against or even wrap around antenna supports without causing any significant change in its characteristics.

The various makes of 300 ohm twin lead are quite inexpensive and their advertised losses look good on paper. However, these figures do not hold if the line is wet, and even the tubular forms of 300 ohm cable show quite large variations of impedance and markedly increased loss under such conditions.

From consideration of all facts and figures, it at first appears that twin open-wire line is the answer to all the problems. The book figures for attenuation per 100 feet at frequencies up to 500 megacycles look very inviting, but these do not tell the full story. The claimed results can only be obtained from open-wire line constructed from large conductors, very closely spaced, to reduce the loss from radiation direct from the line. The wires must be supported and held apart from each other with the minimum number of spacers, and these should be fabricated out of material suitable for the frequency in use. There must not be any sharp bends in the line, and it must be supported so that it remains balanced with respect to ground, and adjacent buildings.

One type of line which has not been used much in this country is the "G-line" so named in honour of G. Goubau, a German born physicist who developed it in 1958, while working at Fort Monmouth in the United States.

This line, although a little more difficult to construct initially, is probably the cheapest to construct if long runs of transmission line are required. It is superior to open wire lines in performance providing it is installed correctly. Most workers are aware that such a line exists, but not a great deal of information about it has been available.

The "G-line" is a simple system, consisting of a single insulated wire, which when excited by the cone shaped "launching" terminations, has very low loss, which does not change markedly with frequency and is not greatly affected by moisture. To secure this performance, the line must not make any acute bends and must be kept clear of surrounding objects by at least half a wavelength at the working frequency.

Why is insulation needed on the line ?

Some readers will say — why is the wire insulated? Air is considered to be the best insulator, and providing the wire is clear of all surrounding objects, it should only require insulating at the ends. To answer this question, first let us examine the electric field within a longitudinal section of solid dielectric coaxial line (see Fig 1). If we could see this field we would find that the field lines exist between centre conductor and outer shield, changing polarity at every half wavelength at the operating frequency throughout the length of the cable. These regions of electric field also seem to progress along the cable at a speed somewhat more than half

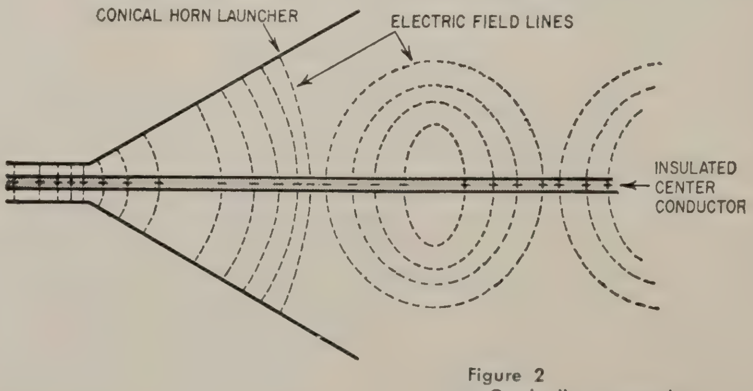


Figure 2
Gradually expanding outer conductor transforming coaxial cable to "G-line". One launcher is required at each end of the "G-line".

the speed of light. (The ratio of the velocity of the wave through the dielectric, to the velocity of the wave in air (strictly a vacuum) is called the velocity factor — for standard coaxial cable this is about .6).

If instead we gradually increase the diameter of the outer shield, the electric field now encounters a region where the overall dielectric is partly air, and partly lower velocity factor dielectric material (see Fig 2).

The speed of propagation of the energy now comes under the influence of two different materials, and the centre of the wave front produced by the electric field is retarded whlst the outer regions propagate at normal speed. This causes the wave front to curl inwards towards the conductor, and consequently does not move outwards away from the line.

If we continue this process, gradually making the outer conductor larger and larger, the electric field remains bent inwards in the form of an arc, causing regions of opposite charge to occur along the same conductor. Thus the electric field becomes imprisoned by the one conductor, whereupon the expanded outer conductor becomes unnecessary and can be omitted.

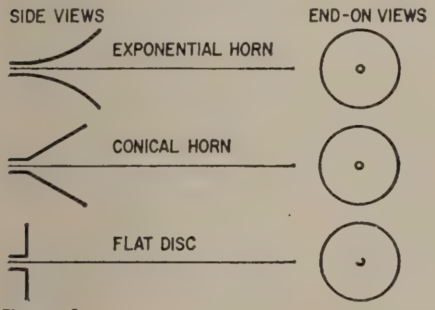


Figure 3

In practice the enlarged portion of the outer conductor is called a launcher. A complete transmission line requires one launcher at each end of the line. Theory states that these launchers should be about 2 to 3 wavelengths long and exponentially shaped, but in practice a conical shape works almost as well, whilst being much easier to fabricate. Some workers have taken the construction of the launcher to the extreme (see Fig 3) — that of a flat disc of similar size and reported only a small increase in loss. No matter how small this loss is, however, in many cases it cannot be tolerated.

What kind of insulation is required?

Once against theory states that the diameter of the single conductor measured over the insulation should be at least twice that of the wire conductor itself. Good quality plastic preferably of polythene or similar material should be used if possible. Rubber type insulation materials are very prone to loss and should not be used.

The characteristic terminating impedance of a G-line is reported by some workers to be in the vicinity of 300 ohms, but others have fed the system with 72 ohm coaxal cable and not reported any significant loss. One way to convert the usual 70 ohm cable impedance to one of about 300 ohms is to use a quarter wave coaxial matching section of about 150 ohms impedance between the end of the coaxial line and the apex of the launcher, which could be made of the same diameter as the outer conductor of the quarter wave matching section.

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Notes from the Australian Scene

Australia will be able to receive television programmes from the United States next year, according to the director of advanced planning for International Telephone and Telegraph in Australia.

By 1970 he claims, the cost of maintaining satellite systems and ground stations will be no greater than that for underground or submarine cables. Next year, a stationary relay satellite will be launched ideally suited for communications between Australia and the United States.

However, the initial cost to television broadcast stations, estimated about £1,600 per hour, will prohibit any but important news programmes being relayed.

The company held a conference in Sydney attended by delegates from all over the world. The main topic was satellite communication.

By comparing the number of additional telephone subscribers connected each year, with the cost of additional exchange plant, etc., the Australian PMG Department have calculated that it costs them £556 to connect each individual subscriber.

Australia's first earth satellite, Australis, is being designed and assembled in Melbourne — by amateur radio operators.

It will weigh 35 pounds and is expected to be launched by the U.S. at the end of this year. Co-operating in the project are the Wireless Institute of Australia, Melbourne University Astronautical Society and Melbourne University Radio Club.

The Australian Supply Department have offered test facilities in Melbourne and Salisbury. It is powered by chemical batteries with an operational life of three months.

Recording stations are to be spread across 50 square miles of Australian desert in an attempt to discover the source of cosmic rays and to measure their energy.

When completed, this system will be largest in the world doing research into cosmic rays. Plans are being made by Cornell University and the University of Sydney.

Buried in the ground at each recording station will be the recording equipment consisting of two liquid scintillators to detect particles from high energy nuclear interactions in the atmosphere. The equipment is said to be so sensitive it can measure to 0.1 microseconds.

Eventually an array of aerials will be dotted across the countryside around the town of Narrabri — already well known in scientific circles because of the stellar intensity interferometer built there in 1960 to measure angular diameter of stars.

Finances for the project will be supplied by the U.S. Air Force and will amount to £100,000. Preliminary work has started on a laboratory base and the whole project may take as long as five years.

FIRST NEW ZEALAND ELECTRONICS CONFERENCE

Some abstracts of the eighty papers being presented

RELIABILITY FROM THE STANDPOINT OF MANUFACTURER AND USER

J. E. Nixon, Victoria University of Wellington

Reliability must not be left to individual conscience and experience. Unremitting vigilance is required from management, maintained by a strict routine which ensures that:—

(a) proven circuitry and mechanical design are employed — novelty must be justified,
(b) it is informed of design weaknesses before change becomes prohibitively expensive,
(c) component selection is based on worst case design and adequate component types,
(d) handbooks, circuit diagrams, colour coding etc. give maximum assistance,
(e) effective feedback from Test and the user is established and a continuing record of each design maintained.

Intending purchasers should satisfy themselves that the manufacturer has adopted controls such as these.

AN 18 CAMERA CCTV INSTALLATION FOR SURVEILLANCE IN A SECURITY ESTABLISHMENT

T. G. Procter, Ministry of Works, Wanganui

The paper describes the C.C.T.V. installation at the Maximum Security Villa, Lake Alice Hospital, near Marton. There are 2 unattended cameras in each of 4 corridors, which vary in length from 130'-173', and in each of 5 rooms sized 25' x 25' and 41' x 30'. Images are presented continuously on 4 pairs of monitors located at a control desk in a watch room. The watch attendant selects cameras in pairs for viewing by depressing associated push buttons. These actuate switching relays.

Standard industrial type cameras and monitors are used. The paper deals with their application to the particular installation not with their design.

THE GRACEFIELD COSMIC RAY OBSERVATORY

K. J. Gough, Coombe St., Wellington

The paper describes electronic aspects of the cosmic ray observatory which has been recording the diurnal variations in cosmic ray intensity at Gracefield for several years. The problems involved in an automated observatory of this type, and the comparitive merits of alternate means of recording are discussed.

A PORTABLE ALPHA COUNTER FOR MEASURING VERY LOW LEVELS OF ACTIVITY IN FOOD, TOBACCO ETC.

F. H. Ellis and R. A. Morris

Physics and Engineering Laboratory, Lower Hutt

This paper describes a portable instrument designed to measure the alpha activity of foodstuffs and other materials. It does this by detecting the scintillations produced in a zinc sulphide screen by the alpha particles. The screen is viewed by a 5" photomultiplier tube and the output pulses are amplified and counted by transistor circuitry. Some information on the source of the particles is obtained from a measurement of the time separation of double pulses. The spurious background count is less than one per hour. The instrument is powered by four lantern batteries which will give several days of continuous operation. Normally these are 'floated' across a small mains unit giving an indefinite life.

ELECTRONIC TELEPHONE EXCHANGES

G. T. McPherson, New Zealand Post Office

Present telephone exchange systems operate on an electro-mechanical basis, which has over the years reached a high state of development. However, the advent of commercially cheap and very reliable electronic devices, notably semi-conductor elements, has ushered in a new era in telephone switching development.

The Paper will describe current developments in electronic exchanges, with particular emphasis on the first commercially viable small-to-medium size system, which has been developed in the U.K. for use in the public network. This system utilises a reed relay space-divided switching path controlled by electronic common equipment, and is of the type that has been ordered for the first electronic exchange in New Zealand. Advantages of electronic over electro-mechanical systems will be covered, with a description of the reed relay switching matrix and the common control, which utilises specialised computer-type storage and logic techniques, and comprises the "brains" of the exchange.

SOME ASPECTS OF SYSTEM PLANNING OF EARTH STATIONS

H. G. Arthur, New Zealand Post Office

Much information is available on the design, launching and orbiting of satellite vehicles but the design and construction problems of that most necessary adjunct, the earth station, are not so well documented.

In giving some notions of the system design issues involved the author discusses the basic telecommunications standards to be met by any system, the choice of frequency spectrum most suitable for satellite communications, and how these factors influence the choice of antenna system, transmitter power and receiver performance. Some related aspects of earth station design are also discussed.

THE MEASUREMENT OF NOISE IN HYDROPHONE AMPLIFIERS

J. M. Tricker

Necessity for the measurement and comparison of noise in low noise low frequency transistor amplifiers led to the use of two methods of noise evaluation, namely Noise Figure and Equivalent Input Noise Voltage. The concept of noise figure and its application to transistor amplifiers is discussed together with a method of measuring this parameter. The use of the equivalent input noise voltage is shown to be a more useful parameter where capacitive hydrophones are used as a generator. A method of measuring this parameter is given.

TELEVISION RECEIVER CIRCUIT DEVELOPMENTS

J. H. Howe, EDAC

A brief outline is given of developments in TV receiver circuits in this country since the introduction of TV broadcasting. A review of present overseas trends in the hybridization and transistorization of receivers indicates probable developments in the near future in this country. Colour receivers in the U.S.A. and Japan, operating on the already established NTSC system for colour reception, are briefly reviewed and the variations to provide reception on alternative colour systems are enclosed. Future development in these receivers, with an assessment of the form in which colour TV receivers might be introduced here, are considered.

PROFILE MILLING BY PROGRAMMED NUMERICAL CONTROL

M. J. Beale, S. Lattimore, W. P. Gabriel and R. A. Morris
Physics and Engineering Laboratory, Lower Hutt

This paper describes an electronic control system for a two dimensional vertical milling machine. Information on the desired profile of the finished work piece is placed on eight hole paper tape in the form of a series of commands and measurements. This information is processed in the control circuits to produce two pulse trains with variable repetition rates. It is the rates of these pulse trains which determine the X and Y velocities of the table of the machine. At the present stage of development the system is capable of machining straight lines and sections of circular arc.

COMMUNICATIONS USING VLF RADIO SIGNALS

G. J. Burtt, Physics and Engineering Laboratory, Lower Hutt

VLF Radio is used extensively throughout the world for naval communications with submerged submarines, for the propagation of time signals and standard frequency information, and for position fixing navigational aid systems.

The advantages of VLF for these purposes are considered. The techniques which can be used are dealt with in relation to the requirements for various purposes and in the light of present day knowledge.

Current programmes of research are directed towards a fuller understanding of the mechanism of propagation, and will probably help in developing these techniques. They will also help to define more thoroughly the limitations of accuracy and reliability under various operating conditions.

THE OPERATION OF V.H.F. & U.H.F. TRANSISTORS AT FREQUENCIES APPROACHING AND BEYOND THEIR CUT-OFF FREQUENCIES

Irving H. Spackman, Chemistry Dept., University of Auckland

This paper summarises the developments of the past five years in the application of V.H.F. and U.H.F. transistors, and discusses some of the techniques used to extend the operating frequency of some readily available types up to, and beyond their normal cut-off frequencies.

The use of, and comparison between, common base and common emitter amplifier configurations at these frequencies is considered, with particular reference to noise figures, overall gain, stability, and overload characteristics. The operation of transistors in "Transit Time conversion" and "parametric" modes, is also described. This leads to discussion of R.F. power generation in such semi-conductors at frequencies from V.H.F. to Microwaves and comparison is made between "Transistor Parametric" frequency multipliers and conventional "Varactor Diode" multipliers.

A MINIATURE VHF RADIOTELEPHONE

R. A. Pannett, AKRAD Radio Corp. Ltd.

A personal portable radiotelephone has been developed which is proving its effectiveness on Industrial sites and in use by Civil Security Services in Britain. The value of this equipment lies in its compactness and light weight, freedom from noise and interference, and particularly in the penetration of its low power VHF signals in built-up areas and heavily screened locations where communication at longer wavelengths is impossible.

Salient features of the transmitter and receiver circuits, designed in accordance with contemporary spectrum conservation requirements are described. Results of field trials with this equipment in Auckland city are quoted.

DESIGN AND PRODUCTION OF A VHF TELEVISION TUNER TO SUIT NEW ZEALAND CONDITIONS

K. A. Tribble, AKRAD Radio Corp. Ltd.

A new tuner unit is described which combines simplicity and high reliability. The basic requirements to suit New Zealand conditions are first outlined and then a detailed analysis of various methods of obtaining the required bandwidth together with attendant problems such as neutralizing, oscillator injection and oscillator radiation are given. It is shown that the new high transconductance frame grid valves now available result in superior performance and lower cost, particularly as regards the R.F. amplifier where a neutralized triode is finally chosen. Different methods of oscillator fine tuning are evaluated in relation to frequency drift, temperature compensation and mechanical stability. The translation of all the required technical features into a finished unit suitable for mass production is described in detail and various performance figures thus obtained are given. Finally the various production methods used are outlined and photographs are shown of some of the more intricate assembly points.

POWER CONTROL USING S.C.R's IN AN ENVIRONMENTAL CONTROL APPLICATION WITH A SWITCHING CAPABILITY OF 0.5 MEGAWATTS

W. P. Gabriel, R. A. Morris and R. W. Robotham*
Physics & Engineering Laboratory, Lower Hutt
*Plant Physiology Division, Palmerston North

Research at the Plant Physiology Division, D.S.I.R., is to be assisted by the production of controlled climates in 25 rooms. The controlled quantities are temperature, humidity, lighting level, and CO_2 content.

The use of silicon controlled rectifier (thyristors) in controlling some of these quantities is described. The large number of control units in the project, and the high total power to be handled, have led to some interesting problems in S.C.R. technology. The application of S.C.R's in climate control is described, with some discussion of malfunctions and interference. The performance of pilot plant currently in operation shows that control by solid state devices shows reliability and versatility.

ENQUIRY CARD AD. 12

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EN.5FP

Accuracy Specifications For Measuring Instruments

by J. Petersen*

Whenever a measuring instrument is to be bought, various points — measurement range, versatility, ease of operation, size, weight and price — must be considered, which assume different importance in every individual case. The manufacturer's reputation may also carry weight in estimating trustworthiness, reliability and dependability of an instrument.

The most important criterion is, however, accuracy. It is obvious that precision measurements require precision instruments. If the requirements are modest, a highly accurate instrument is uneconomical since accuracy costs money. Nevertheless a precision instrument is often preferred since it saves time by dispensing with tedious error calculation, imparts confidence in its reliability, and also includes a margin for more exacting measurements.

The manufacturer specifies the accuracy of his instrument in the data sheet. The error to be expected in the most adverse case, written as "error< ± a%" or "error limits = ± a%", has long been used as a measure of accuracy. The specification of accuracy in numerical values is problematic if information on the positive or negative character is to be included. The figures would have to be near 100% and values above 100% would make no sense. On the other hand it is illogical to speak of accuracy when quoting the error, as is done occasionally.

The manufacturer will formulate the error limits with adequate caution to anticipate complaints which might have an adverse effect on his reputation. It would, however, be unwise to be unduly careful and present the product in a less favourable light than necessary. The facts should always be stated accurately; this requires, however, careful and comprehensive tests before a product is released for general sale. Since these tests cannot be made on an instrument still in the stage of development, it is common practice to specify tentative error limits in order to avoid misunderstandings.

When looking through data sheets, the buyer wishes to find comparable specifications enabling him to make quick and suitable comparisons with competitive equipment. Efforts have therefore been made to establish national and international rules for the specification of technical data and errors. The VDE (association of German electrical engineers) is working on this problem and also the IEC (International Electro-technical Commission) on an international level.

The task of these committees is not easy for various reasons:

- Firstly the abstract concept of "electronic measuring instrument" must be developed from a great number of existing electronic measuring instruments serving the most varied purposes.
- Secondly, electronic measuring instruments are mostly more complex than, say, electrical measuring equipment and therefore more difficult to depict. Many of their characteristics cannot be described by one figure. For instance, in order to characterize the output signal of a signal generator information must be given on frequency, voltage, waveform, modulation, distortion and signal-to-noise ratio.
- Thirdly, interactions may exist between the operational quantities determining a characteristic. A typical example is the frequency response, i.e. the dependence of, say, an output voltage or the sensitivity on frequency. Reaction of external conditions must also be expected, in the case of a signal generator, for example, a variation of the adjusted frequency or of distortion resulting from changes of the load.
- Fourthly, electronic measuring instruments are subject to a great number of varying ambient conditions which may influence their errors. Proposed lists of factors to be observed include supply voltages, climatic conditions, external magnetic fields, radioactive radiation, etc. Time can also be considered as an ambient influence covering all phenomena of instability and aging.

Faced with this multiplicity of problems, standardization, in itself a complicated procedure, progresses slowly and up to now has hardly passed the stage of recommendation drafts. It is, therefore, too early to use international standards or even to discuss them publicly. A few basic considerations will, however, be briefly outlined.

A data sheet should contain all the technical data that are important for the use of an instrument and that can be measured or checked externally including their tolerances. Data given without specification of tolerances merely show the order of magnitude; if they or the term "approximately" sometimes accompanying them were to include the notion of a given range of spread (e.g. ± 10% or ± 50%), as is sometimes assumed by readers, this range would have to be stated as tolerance.

The tolerances (T) are divided into errors (F_0) existing under nominal conditions and variations (ΔF) of these errors due to permissible deviations (Δx_i) of individual influences from their nominal values within the range of application. Tolerance is thus defined like a total differential by partial derivatives:

$$T = F_0 + \Delta F$$

$$= F_0 + \frac{\lambda F}{\lambda x_1} \Delta x_1 + \frac{\lambda F}{\lambda x_2} \Delta x_2 + \dots$$

The errors existing under nominal conditions, i.e. at fixed values or within fixed ranges of the AC supply voltage, AC supply frequency, temperature, warming-up period, calibration frequency, nominal lead, etc., constitute the real inaccuracy of an instrument re-

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* Courtesy Rohde & Schwarz

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sulting from its design and manufacture. They are often called "inherent errors"; their reduction either increases the price of the instrument or is impossible for technological reasons.

Some manufacturers of instruments merely state these inherent errors; their data sheets are thus concise and show low error values, giving a good advertisement of the product. However, this method only serves those customers who are lucky enough always to work under the nominal conditions.

The error variations due to external influences ("additional errors"), which are typical of the instrument performance in the whole range of application, can under certain circumstances also be kept smaller in instruments of a higher price category. The manufacturer should at least know them. If, as the standardizing bodies propose, he publishes them, thereby undertaking a guarantee, his test methods become more expensive and the data sheets more lengthy and complicated. The inexperienced customer, not to mention the technically untrained purchasing clerk, may be discouraged by the multiplicity of restrictive specifications and see the instrument in an unfavourable light. On the other hand, a highly detailed data sheet enables the expert to weigh up the influences and judge which of them he has to allow for and which he may neglect since he either will not encounter them or can suppress their effect by voltage stabilization, temperature control, etc. The more careful the customer is in making a purchase, the more he will welcome every detail and place confidence in an offer that gives this information beforehand.

Many companies make every effort to comply with international standards as soon as they are adopted and published, but do not conceal the fact that the introduction of classes as used for electrical measuring instruments, which is being discussed in various circles, is considered unsuitable for electronic measuring instruments. According to this proposal, all inherent errors of an instrument in a given class should remain within given limits which are interdependent and all the additional errors due to external influences should not exceed these values either.

Such a system tends to favour and cultivate instruments in which all characteristics harmoniously agree with each other and therefore seems beneficial at first glance. But to fix the relation between all possible inherent errors and external influences involves serious risks, above all in an economical respect. A single error exceeding the class limits, however unimportant it may be in most applications, sends the instrument into a lower class. The elimination of this error for the sake of a better classification may cost a lot of money and increase the price unnecessarily. Owing to this systemization, data standardization, intended to help the buyer of equipment, would have the contrary effect and become a hindrance.

◆

Annual Convention:-

AUCKLAND V.H.F. GROUP

The Auckland V.H.F. Group (Inc.) held its 6th Annual Convention at the Museum of Transport and Technology during the weekend of 23rd and 24th April. 62 people from all over the North Island attended the full weekend, whilst a number of others attended for part of the time. One very pleasing feature was the large number of women attending and participating in both the technical and social functions.

The weekend commenced with a social evening on the Friday night. The Saturday morning dawned fine and the first activity for the day was a mobile rally in which 12 radio equipped cars took part, covering a course of nearly 50 miles through the northern side of Auckland. The V.H.F. Group's official radio station ZL1BQ participated in this event acting as a Control and Monitor station, and was equipped with a high frequency decade counter and other equipment for checking the mobile stations whilst tape recordings were also made for replay later.

After luncheon, the Convention was officially opened by the President of the Group. The two official guests who were to deliver the afternoons' lectures were introduced. The first of these "The Phenomenon of Scattering of Radio Waves in the Ionosphere and Troposphere" was delivered by Dr. H. A. Whale, Director of the Radio Research Centre, University of Auckland. After afternoon tea Mr. K. Shankland of Pye Telecommunications Ltd., described techniques, and displayed some equipment used with 450 mc/s. telemetry systems.

The evening began with cocktails followed by an excellent dinner. The rest of the evening took the form of a social with the presentation of various prizes, the mobile rally awards, trophies and certificates for the 1965 V.H.F. Field Day. A special award sponsored by Messrs. Amalgamated Wireless (Aust.) N.Z. Ltd., for meritorious work on the V.H.F. bands, was presented to Ian Sterling ZL1AGU. Dr. Whale and his wife presented these awards and trophies.

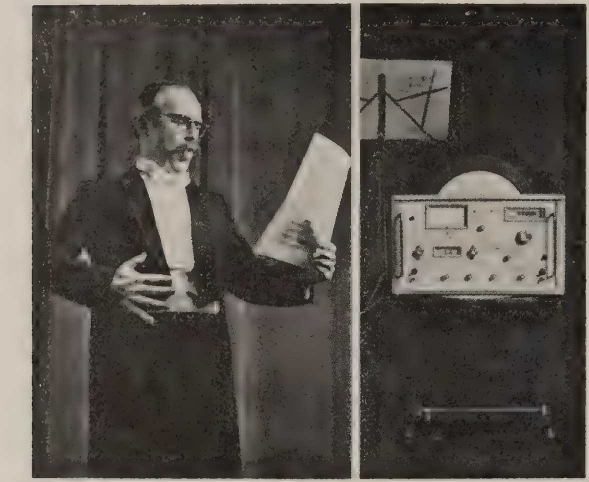
The Sunday morning activities took the form of a Technical and General Forum to discuss matters pertaining to V.H.F. work, and it was generally agreed that more time could have been devoted to this section. At midday the official part of the activities concluded but the Sunday afternoon was taken up by visits arranged to the Electronic and Radio-Radar installations at Whenuapai Aerodrome (by the kind permission of the R.N.Z.A.F.) and the recently completed studios and control rooms of AKTV2 (by the kind permission of N.Z.B.C.).

Everyone who attended registered their appreciation of the work of all those who contributed to making the convention the success it was, and voiced the hope that a similar function would be held in 1967.

ENQUIRY CARD AD. 12

focus on our agencies

One way to perform a low-frequency study A better way from Sierra



Our **basso profundo** solos confidently through a rough harmonic passage in the certain expectation of success. How can you be equally sure to rate curtain calls with your low-frequency signal studies? One sure way is to call for an obbligato from Sierra's new Model 301A wide-range, low-frequency wave analyzer.

Model 301A provides continuously tunable coverage of 20 Hz to 100 KHz, with direct numerical readout to the nearest 10 cycles, and 2 Hz interpolation marks. Frequency accuracy is 0.1% at 100 KHz. Dual selective bandwidths of 10 and 100 cps keep you in control of signal-to-noise, with AFC holding unstable signals within the 10 Hz filter bandpass. Price of £1072/6/3 duty paid, delivered, is designed to fit the passband of your budget.

You'll also find Model 301A well-versed in performances as a tracking signal generator and as a selective voltmeter with restored signal output. Call or write Sample Electronics for further details.

Increased frequency range (DC18Gc) in Weinschel precision fixed attenuators . . . at lower prices!

Models 1 and 2 precision fixed coaxial attenuators feature a new patented design principle, plus new film and connectors which make them amazingly flat, stable, even after overloads of power or during variations in temperature. A semi-precision modified Type N connector that can be mated with existing Type N connectors in your system extends use up to 18 Gc. Absolute broadband accuracy of ±5% in db includes deviation from nominal, calibration error, and frequency sensitivity.

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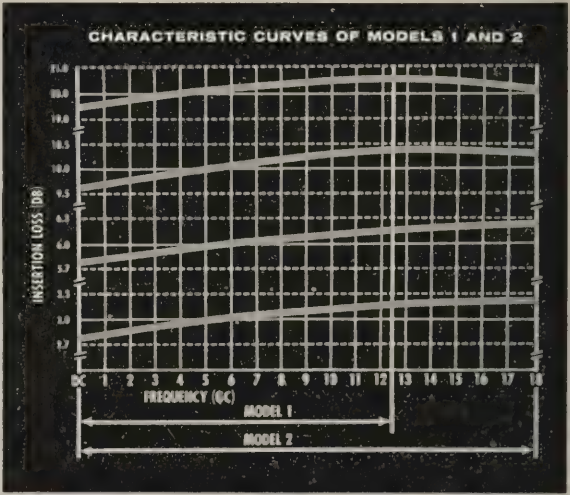
Prices: Model 1 £43/0/0 Model 2 £67/3/9 Duty-paid.



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BOOK REVIEWS . . .

RELIABILITY OF ELECTRONIC COMPONENTS

by C. E. Jowett,, 165 pp (illus.)
Publ. by Iliffe Book Ltd., London

This book is more in the way of a review of the subject rather than an exposition of a new form of component reliability. It is carefully written and covers most components found in electronic equipment but leaves virtually untouched mechanical hardware and metallic chassis work.

An appreciable part of the text deals with the specifications and characteristics of components and is, thus, a valuable source of information; this is especially the case in this country where the obtaining of information from agents is a difficult job.

The effects of environment are briefly dealt with, usually in each chapter, and it is here that a more detailed approach to the subject would be welcome in that the author could have presented us with specific advice on this most important aspect of reliability.

It is unfortunate that the opportunity was not taken to discuss the effects of "running to the limit" and the degradation of reliability when this is done. The effect of say, temperature, on the life of transformer winding wire (for instance) is important when short life equipment is being designed. The book has a minimum of formulae or mathematics and as the probability of failure needs mathematical treatment we must assume the author intended this volume should be welcome where mathematics is not — in production and service departments. C.W.S.

TRANSISTORS FOR TECHNICAL COLLEGES

by L. Barnes, 194 pp (illus.)
Publ. by Iliffe Books Ltd., London

This essentially practical book is not only ideal for students at technical colleges and institutes but should find interest among older engineers seeking a background in transistor work.

Of seven chapters five are devoted to the transistor in service. The first chapter deals with the basic transistor as a diode and double diode form and the final chapter has a useful collection of experiments.

The practical slant of Mr Barne's text is emphasised by his use of the OC71 transistor in examples and text. Chapters two and three cover, in some 40 pages, the basics of gain leakage and internal resistances in practical circuitry and then carry on with the three forms of amplifiers with three practical design examples in some detail. T circuits and h parameters are then dealt with for low frequency circuits and the fifth chapter covers high frequency effects and limitations due to transistor characteristics and this is followed by a full chapter handling the transistor as a switch.

The final chapter of 12 experiments starts with an experiment on transistor diode characteristics, then handles the static characteristics. The following experiments deal with the transistor as amplifiers, oscillators and multivibrators. These experiments make this section particularly useful for students studying at home or by correspondence who want to confirm textural subject matter by personal experiment.

The book relies upon a familiarity with standard theorems and methods such as apply to load lines and networks but as it is probable these would be understood by the reader the superficiality of explanation in the aid of clarity of result and practicality is warranted.

Few errors were noticed and these were obvious and did not detract from the explorations or results given. Although not intended for the advanced student or worker some more recent, and very practical, advances in transistor production such as silicon and complementary transistors receive scant mention and detract a little from the aims of practical circuit design as some of these newer transistors make circuit design considerably easier. Whilst not quibbling with the choice of the OC71 for illustrative purposes in the text (it is, after all, extremely cheap and easily obtainable) circuit comparison with a modern low noise silicon type would have been a useful recognition of advances in the art of design.

Nevertheless, this is a book that we thoroughly recommend because of its practical approach and easy to follow text. Whilst intended for technical students it would be ideal for the keen amateur or valve educated engineer wanting to get a grasp on transistor design. C.W.S.

BEHAVIOR OF METALS UNDER IMPULSIVE LOADS

John Pearsons, 247 pp
John Pearson
Pub. Dover Publications, Inc.,
New York

This book contains a very general survey of present knowledge. The topics covered in the bibliography are even more wide-ranging. The authors build up a good physical picture of impact phenomena by describing a large number of tests. Mathematical treatment is kept to a minimum and this avoids distraction from the main line of physical argument. The result is a very readable book which achieves its aim of giving a general understanding of the current state of the subject, which is evidently progressing rapidly with much urgent work still required. The importance of this field is increasing as the main emphasis moves from ballistics to metal forming. The book is of value to anyone who wishes to obtain a general picture of this growing field. R.I.S.

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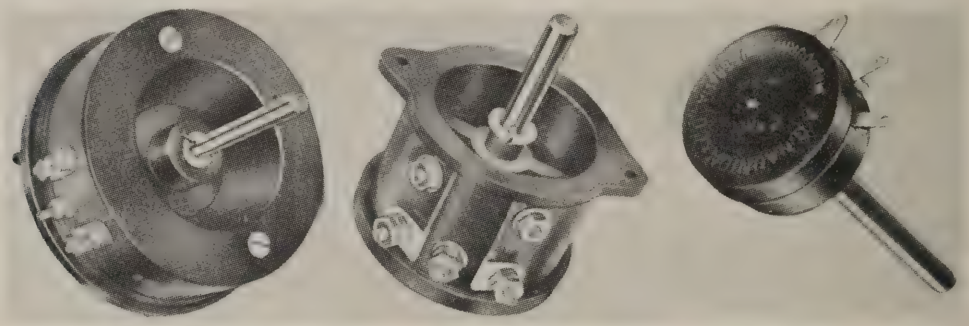

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Mounting	⅜" diax 32 TPIx ⅜ long	2 ext lugs ⅛" dia holes 2¼" centres	2 holes 2⅞ centres tapped 3/16" whit
Contacts		Silverplated Brass	
Winding strip	"A" grade bakelite and Glass filled nylon	"A" Grade bakelite	
Rotation (Mechanical)	270°	290°	338°
(Electrical)	266°	270°	317.5°
Starting Torque	3 oz inches	3,3 oz inches	3 oz inches
End stop	12 lb inches	15 lb inches	15 lb inches
Lubrication		Silicon oil or grease	
ELECTRICAL DATA			
Resistance Range	¼ ohm to 100K linear only	1 ohm to 500K linear 1 ohm to 300k 3-1 taper 1 ohm to 200k 4-1 taper	1 ohm to 1 meg linear 1 ohm to 500k 4-1 taper
Tolerance	.25 ohm to 50 ohm ± 10% 50 ohm to 100K ± 5% special order ± 2% within 1%	± 5% all special ± 1% .5%	± 5% special ± 1% .5%
Linearity tol.	whole element 2 watt	5 watt	10 watt
Power Rating			
Insulation Shaft to Wiper arm:	3000v DC	3000v DC	3000v DC
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ENQUIRY 319

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Glass fibre p.w. board is available from stock, in Wellington. This glass fibre board is made by the Taylor Corporation, U.S.A. and is available in a standard sheet size of 36" x 48" and in a standard thickness range.

At present the only grade normally stocked in 4' x 3' sheets is GEC500E. This grade has 1/16 inch thickness board coated on one side only with 2 oz. copper foil.

ENQUIRY 315

* * *

STATIC ELECTRICITY DETECTOR

Detection of static electricity that exists between improperly grounded or bonded objects is the task of the Sweeney SWE 1125 static meter. The operator holds the static meter in one hand and touches its tip to the object under test. With his other hand he grasps the ground lead or bonding connection to make a circuit. A trigger switch activates the indicator. There are no digital or incremented readings to interpret or convert. A green and red dial shows whether good grounding or bonding has been accomplished. It is impossible to obtain a green (go) reading if the instrument is faulty. The instrument has a self-contained power source and requires no other instrumentation or wiring. If the indicator moves to the red (no go) region the object is unsafe and the position of indicator (right or left of centre) designates the polarity of the charge accumulation on the object being tested. Agents in N.Z. are P. H. Rothschild and Co. Ltd.

ENQUIRY 318

* * *

SOLAR ENERGY FOR RADIOTELEPHONE SYSTEM

The sun's rays have been harnessed to provide electricity for a motorway emergency radio-telephone system in Ghana. Supplied by a British electronics firm, the equipment is thought to be the first of its type to utilise solar energy.

Installed alongside 12 miles of motorway, the telephone network is said to show a substantial saving in both capital and installation costs over more conventional systems.

Five pairs of telephone boxes are spaced at two-mile intervals along the motorway and are connected to fully transistorised radio terminals which consume only one watt of power when in use.

The sun's rays are collected through a panel of cells, mounted — with the radio terminal, its batteries and a charge regulator — on a 40 ft. high mast topped by a directional aerial. Power output of the transmitter is about one third of a watt.

The terminals of the system are connected to each other by a separate exclusive radio telephone link.

A motorist in trouble can contact a terminal simply by entering a call box and lifting the telephone handset. Immediately, he is given exclusive communication with the terminal and no one can interfere with his call. As there is no need for the controller in the terminal to call motorway boxes, this facility is not provided.

The low call-rate, the one-way calling system and the low power requirement of the system make the use of solar energy chargers for the nickel cadmium batteries a feasible proposition in suitable latitudes and locations, say the makers.

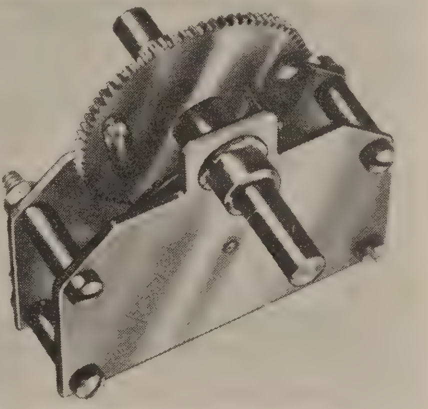
ENQUIRY 316

* * *

PRECISION DRIVES

The new G.80 slow-motion drive meets the stringent specification of the British General Post Office for drives for tuning radio and communications receivers. It comprises a 10:1 friction drive and an 8:1 gear drive in series, giving an overall reduction ratio of 80:1.

The friction drive consists of two phosphor-bronze discs gripping a small steel flange on the input shaft; this arrangement eliminates lost motion but slips under excessive torque to protect the unit from damage. Lost motion in the gear drive is prevented by using twin gear wheels sprung against one another to grip the pinion firmly. Dimensions of the drive are 2 in. x 2 5/16 in. frontal area by 5/8 in. deep.



Another precision drive, intended for commercial radio receivers, is the 6/36 which consists of two epicyclic ball-drive units in series, the second restricted to 300° of angular movement, after which it transmits direct drive. This enables the output shaft to be moved rapidly, at 6:1 ratio, to an approximate position, then reversed at 36:1 ratio to the exact position required. The drive is supplied complete with pointer, scale and escutcheon in modern style.

ENQUIRY 323

Location of leak (in this instance 77' 5" up toll telephone duct in Burlingame, California) is determined by craftsman, who notes intensity meter and characteristic hissing sound on earphones. Surlyn "butterfly" on aluminium rods holds coaxial cable firmly in slot and guides transport in duct. This Delcon instrument is represented in N.Z. by Sample Electronics.

ENQUIRY 322

ENQUIRY CARD AD. 16

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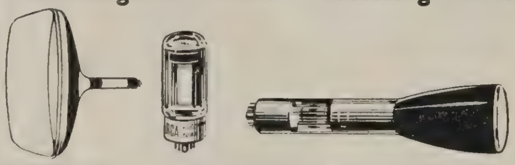

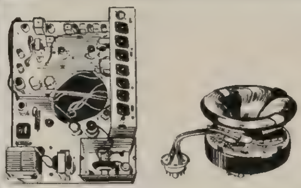

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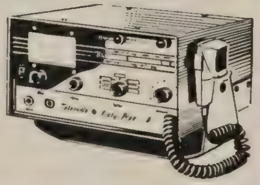

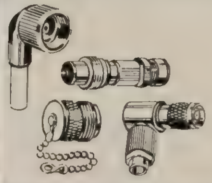

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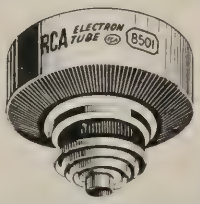

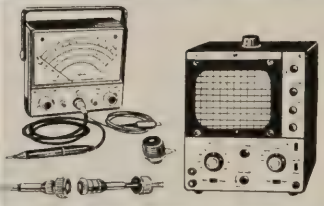

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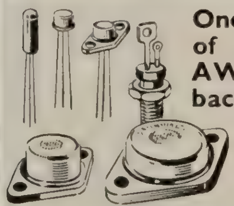

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VR.30

STATIC MONITOR

The Sweeney SWE 1145 static monitor automatically gives visual and audible alarm when preset static voltage is detected — without the sensing probe being in contact with the measured source. It continuously monitors effectiveness of existing static control devices and displays quantitative measurement of negative and positive static voltage.

It is designed for use in any area where the possible build-up of static voltage is of concern, e.g. hospital operating rooms, fuel storage and handling areas, mining and construction operations and manufacturing industries such as textiles, explosives, plastics and printing and processing of paper.

The unit consists of a sensing probe and a separate meter and alarm system. The probe is contained in an explosive proof housing and is electrically connected to the instrument by conduct.

The probe can be located anywhere from 1 - 10 ft. from the object. It will detect static changes on stationary or moving equipment, personnel or material in the region of its outward electric field, thus checking the effectiveness of devices used to neutralise static changes.

For convenience of controls and display the instrument is located elsewhere. The probe will detect charges as low as 10 volts at close proximity to the object and will respond with reduced sensitivity to charges more distant that 6 ft.

To meet requirements where static voltages commonly occur at levels of thousands of volts, probe sensitivity can be reduced by a sliding electrical shield. Fully extended, the slider provides a full-scale read-out for 20 KV of static approximately 2 ft. from the probe. The probe is 7 in. long, base 4 in. dia. with weight of 3lb. Height of the instrument is 8 in., width 10½ in., depth 8 in., and weight 5 lb.

ENQUIRY 314

* * *

CRYSTAL-CONTROLLED TIME-MARK GENERATOR

A new crystal-controlled, wide-range, time-mark generator, Type 184, has been announced by Tektronix, Inc. Unique in having a 500 MHz output, the Type 184 provides 16 marker intervals, 5 sine-wave frequencies, and 7 trigger-pulse intervals. All but the 2-ns and 5-ns sine waves are selected by pushbuttons; the 2-ns and 5-ns sine waves are selected by a lever switch.

Marker pushbuttons are self cancelling, so that when any marker is pushed, other buttons are automatically released. Markers up to 2 decades apart may be stacked by pushing the desired buttons simultaneously. Triggers are time-coincident with the corresponding markers.

The Type 184 is transistorized, plus 6 nuvistors, and is frequency controlled by a temperature-stabilized 10-MHz crystal oscillator. Long-term stability is 3 ppm/24 hours.

Positive-going markers are provided from 100 ns to 5s in 1-5-10 sequence, 1-volt minimum amplitude into 50 ohms. Marker amplifier output provides positive or negative going markers with 14 intervals of 1μs to 5 s in 1-5-10 sequence, 25-volt minimum amplitude into 1000 ohms.

Sine-wave outputs include 2 ns, 5 ns, 10 ns, 20 ns, and 50 ns signals. Trigger output provides positive going pulses with 7 intervals of 1 μs to 1 s in 1-10 sequence, 0.4-volt minimum amplitude into 50 ohms. The Type 184 is only 6" high, 9" wide, and 15" deep. Weight is approximately 15 pounds.

ENQUIRY 309

* * *

C-BAND FERRITE CIRCULATORS

A pair of C-band ferrite circulators for high power applications has been developed by Raytheon Company. The CCH13 has a frequency range of 5700 to 5900 megacycles. Peak power is 150 kilowatts while average power (based on 2:1 mismatch) is 2.7 kilowatts. Isolation is 25 db minimum for ports 2 to 1 while other paths offer 20 db minimum. Maximum VSWR is 1.15.

Operating in a band between 5400 and 5900 megacycles, the new CCH14 can handle peak powers to 1.6 megawatts and average power of 10 kilowatts. Isolation is 20 db minimum and VSWR is 1.20 maximum. Each of the Raytheon assemblies is 23.25 inches long and is fitted with CPR-137F flanges and WR-137 waveguide. Insertion loss for the circulators is 0.5 or less.

ENQUIRY 300

Radio, Electronics and Communications

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JUNE, 1966

AUTOMATIC CONTROLS

An American company is producing simple, accurate and reliable electronic devices to control air conditioning and heating systems. They feature solid state controllers, actuators with only one moving part and are applied to valves, dampers and auxiliary equipment. The design is said to reduce maintenance costs. **ENQUIRY 326**

* * *

CLOSED CIRCUIT TV

An attack on the expanding closed circuit television market is being made with the introduction of a new range of transistorised equipment. It includes a rugged, low-cost, fully transistorised vidicon camera and two monitors — an 11-in. transistorised monitor and a 19-in. video monitor. The system has a standard of definition claimed to be higher than that of a domestic television set.

A range of associated equipment is available for simple one camera/one monitor or complex multi-camera installations. Of small size and light weight, the camera is easy to conceal and can be used in places inaccessible to many other cameras.

Another feature of the camera is that all its circuits are contained in three plug-in modules which enable on-the-spot servicing to be carried out in minutes by unskilled personnel, simply by plugging in a replacement circuit module.

This closed circuit television system gives definition and facilities comparable with those of any general purpose system currently available and at a price midway between that of high and low cost systems.

Particular attention has been paid in the design of the equipment to the need for rugged construction. The camera body and cover are of aluminium alloy and the camera has automatic sensitivity control over a range of 1000:1. Electrical focus is pre-set and stabilised; optical focusing is adjusted by a rear-mounted focusing knob. A wide range of lenses may be fitted.

The equipment has already been ordered for applications in traffic control and civil engineering in Britain. **ENQUIRY 325**

* * *

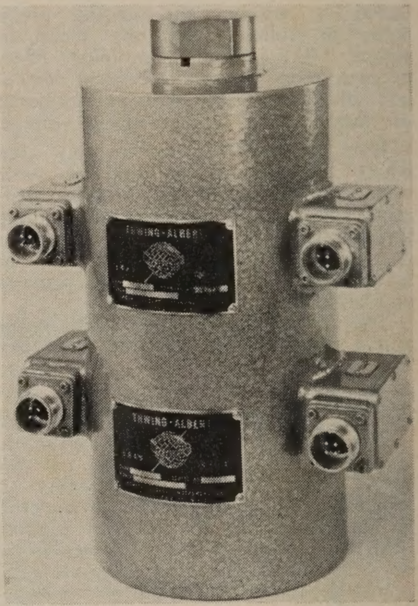
DUAL CAPACITY LOAD CELL

The Sentronic Division of the Thwing-Albert Instrument Company, represented by W. & K. McLean Ltd., has announced the development of its new Duocell, a dual capacity load cell.

The Duocell features, for the first time, a dual capacity unit which provides two load cells within a single housing. Ratios between lower and upper ranges within the cell can be expanded as much as 5 to 1. Each range provides a 3 millivolt per volt output signal at rated capacity. In this manner the load cell is capable of producing a higher output signal at the lower range.

The Duocell is a new concept in load cell design that maintains precision temperature compensation and 0.1% accuracies at each range. Combinations of 10 and 50 pounds to 40,000 and 200,000 pounds can be supplied to meet customer requirements.

The cell is also available in double bridge configurations, thereby producing two matched signals for each rated capacity.



The multi-purpose Duocell saves time and effort normally expended in changing from one load cell to another. In addition to these salient features, costly ancillary equipment is eliminated due to the higher output signal at the lower range.

ENQUIRY 320

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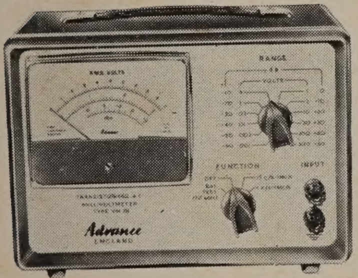
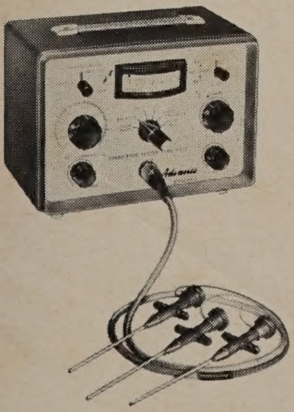
VM78



Battery-operated Transistorised A.C. Millivoltmeter

Voltage ranges 0·001, 0·003, 0·01, 0·03, 0·1, 0·3, 1, 3, 10, 30, 100, 300V. *Overload protection* Protected for inputs up to 400V peak on 0·3V and higher ranges, and for 100V r.m.s. on 0·1V and lower ranges. *Frequency range* 1c/s to 1Mc/s. *Accuracy* ±3% F.S.D. *Input impedance* 2MΩ shunted by approximately 30pF. *Temperature range* 0 to +45°C. *Noise* Less than 50μV referred to the input, when terminated in 47kΩ or less, on the 0·001V range. Residual reading less than 3% of F.S.D. on all other ranges. *Dimensions* 8⅞in (22·5cm) wide × 6½in (16·5cm) high × 5½in (14cm) deep. *Weight* 6·6lb (3kg).

TT1S



Transistor Tester

Battery operated for testing p.n.p. or n.p.n. transistors in situ.
Current gain (*Beta*) 10 to 100, 50 to 500. Accuracy with transistor out of circuit, ±5%; with transistor in circuit, dependent on base shunt circuitry. *Set current* Nominally 1 to 50mA (dependent on shunt circuit). *Balance* Shunt collector circuits of greater than 100Ω can be balanced out by the instrument. *Leakage current measurement* (grounded emitter I'co) 0 to 100μA and 0 to 1mA, with transistor out of circuit. *Diode measurements* Reverse leakage measurement as for I'co. With 10mA of forward current, meter will indicate voltage drop across diode (2V F.S.D.).

Dimensions 8⅞in (22·6cm) wide × 6½in (16·5cm) high × 5½in (14cm) deep. *Weight* 6¼lb (3·1kg).

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SILICON DIODE POWER TRANSFORMERS AVAILABLE FROM BEACON RADIO LTD.

R98 T.V. POWER TRANSFORMER

For R.T.V. & H. 1959 and later T.V. Sets. Delivers 260v @ 300mA D.C. Full wave voltage doubler.
230:115v A.C. @ 300mA D.C.
:12.6v C.T. @ 5A (2 windings ea. 6.3 @ 5A).
:0—6.3—7.5—9 @ .6A. Picture tube winding.
Choke:—C36. Use 400v P.I.V. Diodes.

R103 Stereo Power Transformer

R.T.V. & H. Aug. 60. 7w Stereo.
230:245v @ 150mA. D.C.
:104v @ 150mA D.C. Voltage doubler Rect.
:6.3v C.T. @ 5A.
Choke:—C42. Use 400v P.I.V. Diodes.

R104 Stereo Power Transformer. 10w

320v @ 320mA. Voltage doubler Rect.
230:130v @ 320mA.
:6.3v @ 6A.
Choke:—C49. Use 500v P.I.V. Diodes.

R105 T.V. Power Transformer For Philips T.V. Kitsets

220v @ 420mA D.C. Voltage Doubler Rect.
230:106v @ 420mA D.C.
:6.3v @ 10A.
:0—6.3—7.5—9 Ov @ 0.3A. Picture tube Winding.
Choke:—C45. Use 400v P.I.V. Diodes.

R106 T.V. Power Transformer for Philips T.V. Kitsets

This type similar to R105 but less Picture Tube boost taps. Main Fils. 12.6v C.T. @ 5A.
220v @ 420mA D.C. Voltage Doubler Rect.
230:106v @ 420mA D.C.
:12.6v C.T. @ 5A (2 windings 6.30v @ 5A each).
:6.3v @ .3A Picture tube winding.
Choke:—C45. Use 400v P.I.V. Diodes.

R108 Small Stereo Headphone Power Transformer

250v @ 22mA D.C.
230:110v @ 22mA D.C. Voltage doubler Rect.
:6.3 @ 0.86A.
Choke:—C41. Use 400v P.I.V. Diodes.

R110 T.V. Power Transformer. For Philips T.V. Kitsets

This transformer uses full wave bridge rectifier. Requires no limiting resistor unlike equivalent voltage double types, also has advantage of no insulated capacitor and lower ripple output with smaller choke.
Output 220v @ 420mA D.C.
230:172v @ 420mA D.C. Full wave bridge Rect:
:12.6v C.T. @ 5A (2 only 6.3v winding @ 5A).
:6.3v @ .3A Picture tube winding.
Choke:—C50. Use 400v P.I.V. Diodes.

R111 T.V. Power Transformer

Similar to R110 but for R.C.A. type Kitsets.
260v @ 350mA from Rect.
230:207v @ 350mA D.C. Full wave bridge Rect.
:12.6v C.T. @ 5A (2 only 6.3v windings each 5A).
:6.3v @ 0.6A. Picture tube winding.
Choke:—C42. Use 400v P.I.V. Diodes.

R112 Oscilloscope Power Transformer

R.T.V. & H. 1963. Calibrated.
230:110v @ 80mA D.C. Full wave voltage doubler.
:6.3v @ 2.4A.
:6.3v @ 1A.
:6.3v @ 1A.
Use 400v P.I.V. Diodes.

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